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A Tool for Evaluating Multi-Echelon
Inventory Models and Material Readiness

by

Thomas Allen Bunker

March 1983

Thesis Advisor: F. R. Richards

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METEOR: A Tool for Evaluating Multi-Echelon Inventory Models and Material Readiness

by

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Lieutenant Commander, Supply Corps, United States Navy
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Submitted in partial fulfillment of the
requirements for the degree of

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ABSTRACT

There are many multi-echelon inventory models in use within the Department of Defense. These models have been used primarily to determine inventory levels at various echelons of supply for complex, multi-indentured, hardware systems. Their objective is, generally, to maximize some measure of equipment readiness, subject to budgetary constraints. These models vary in their structure, assumptions, mathematical objectives, and optimization procedures.

This thesis examines the characteristics of these models and offers an alternative simulation model, Multi-Echelon Technique for Evaluating Operational Readiness (METEOR), which can be used as a common framework from which to compare and evaluate the analytic models. In the examination of other simulation models used by the Navy, it is believed that METEOR is unique in its ability to accomplish this purpose. METEOR may also be used to evaluate the impact of changes in supply related policy on equipment readiness.

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I. INTRODUCTION

Commercial enterprise has traditionally regarded profit as a primary motivating factor in decision making. Decisions to make or buy, sell or lease, invest or spend, are usually guided by the notion of profit. By using profit, or a suitable surrogate, as a measure of effectiveness, decision alternatives are readily quantified. In regard to matters relating to logistics support, and inventories in particular, businesses have generally sought to minimize their costs. Cost minimization is a reasonable surrogate measure of effectiveness in this instance, in that reduced costs in an overhead account are tantamount to increased profits -- the underlying objective.

Historically, the Department of Defense has used the same general models as industry to establish inventory levels at their numerous inventory stock points. Clearly, the objectives of the Department of Defense are not profit oriented. This obvious fact has been duly recognized in the recent past and policies have shifted accordingly. The following excerpt from the FY78 Defense Authorization Act is evidence to this fact.

> The budget of the Department of Defense submitted to Congress for Fiscal Year 1979 and subsequent fiscal years shall include data projecting the effect of the appropriations requested for material readiness requirements.

Logistic support of complex weapon systems is a large part of the resources to readiness problem addressed above. This, together with other high level directives and policy guidance, has provided the impetus for the development of inventory models that measure hardware performance and mission readiness characteristics.

Additionally, when seeking the most effective utilization of resources, one must know where those resources should be placed to have the greatest affect on the total force readiness structure. Optimizing at each hierarchical level of an organization will rarely result in an optimal strategy for the whole. In response to this need, inventory models have been developed which encompass the entire supply system rather than individual levels, or echelons, which make up the supply distribution network.

A general class of models has evolved which feature both equipment related performance objectives and multi-echelon supply optimization. Unfortunately, the complex modeling issues involved prohibit the use of exact mathematical representations and closed form analytic solutions. It is, therefore, extremely difficult to objectively evaluate the relative merits of these models. In this thesis, one approach is offered. It is a simulation that features a multi-indenture, equipment oriented model, Multi-Echelon Technique for Evaluating Operational Readiness (METEOR), that generates demand on an integrated, multi-echelon supply system.

Chapter II provides a brief backround and some common characteristics of multi-echelon models. An objective shared by many such models, operational availability, is discussed in some detail. Chapter III outlines the primary multi-echelon simulation models currently in use by the Navy. It concludes that METEOR is unique in its ability to assess multi-echelon inventory models and the supply system's impact on weapon system performance in a shipboard environment.

In Chapter IV, the equipment related aspects of METEOR are presented. The hardware system, its operation and measured performance, is modeled through the use of TIGER, a product of the Naval Sea Systems Command. TIGER's operating

characteristics and options are reviewed and discussed. Chapter V offers a detailed presentation of the METEOR simulation. The potential user of METEOR is provided, in the appendices, with the documentation necessary to understand and exercise the simulation.

Finally, in Chapters VI and VII, the reader is provided with model validation results, concluding remarks, and recommendations for future research.

II. MULTI-ECHELON INVENTORY MODELS

A. A BRIEF HISTORY

Classical, analytic inventory models have been in use in both the public and private sectors for many years. The earliest and perhaps most well known model is Wilson's Economic Order Quantity (EOQ) formula. The field now abounds with a multitude of variations on that model, but at the heart of each, two considerations are generally implicit: (1) the objective function minimizes the total variable cost of inventory, and (2) given a hierarchical supply network, an individual inventory stock point acts (optimizes) independently of its source of supply, lateral counterparts and customers in terms of system-wide inventory levels.

The term "multi-echelon" first appeared in the literature in 1958 in a research memorandum by A. J. Clark of Rand Corporation working under contract to the Air Force. The model used dynamic programming techniques in pursuit of optimality but made no claim that optimal solutions would be achieved. Most importantly, however, there was a perceived need to integrate the inventory stockage policies of complex, hierarchical supply systems. During the ensuing decade, Rand Corporation continued research in the field of multi-echelon systems, and, in 1965, Craig C. Sherbrooke published "METRIC: A Multi-Echelon Technique for Recoverable Item Control" [Ref. 1]. It was purported to be the first multi-echelon, multi-item model proposed for implementation. A notable feature of this model was a shift in emphasis on the objective function from one of cost minimization through arbitrarily assigned backorder costs to

that of system performance maximization. As Sherbrooke stated [Ref. 1],

> Instead of computing stock levels on the basis of artificial estimates of holding cost rate and backorder cost, this approach focuses management attention on the entire weapons system so that an appropriate combination of system effectiveness and system cost can be selected.

There have been several multi-echelon models developed since that time. In the Department of Defense, each service has adopted different models. Although each service has employed more than one such model, the following three deserve mention:

1. Availability Centered Inventory Model (ACIM) - Navy
2. Multi-Echelon Technique for Recoverable Item Control; Modified (Mod-METRIC) - Air Force
3. Selective Stockage for Availability, Multi-Echelon (SESAME) - Army

Some of the common characteristics and features of these models are discussed in the paragraphs that follow.

B. CHARACTERISTICS

The models referred to above have been developed primarily for use as tools to be used in the determination of inventory levels at various supply echelons for complex equipments and/or hardware systems. The number of echelons represented can be as few as two, or in some cases, may be theoretically unlimited. A typical supply echelon structure is shown in Figure 2.1 .

The hardware systems are typically modeled as a hierarchical series of components and subsystems, commonly referred to as indenture levels. Again, the number of indenture levels representable by any particular model varies, but is generally limited to two or three. In most

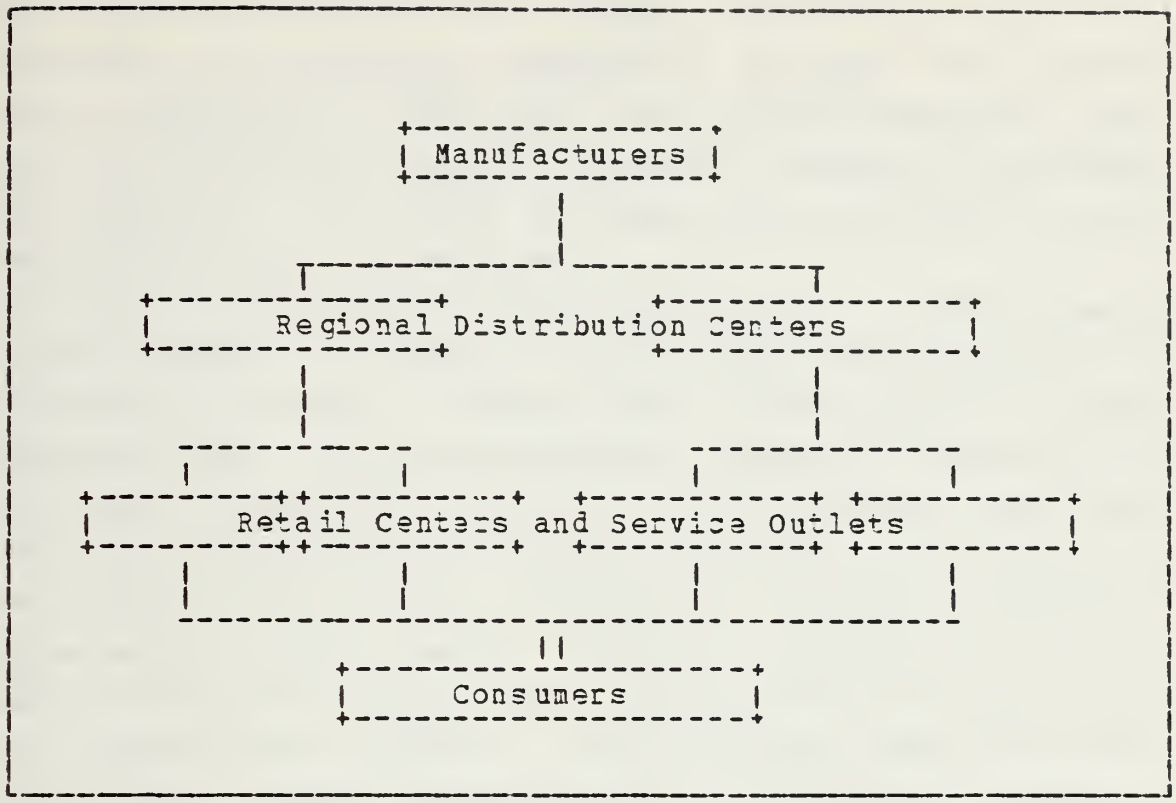

Figure 2.1 Typical Supply Echelon Structure.

cases, the components are treated as being connected in series in a reliability sense and, therefore, a failure of a component results in failure of the system.

Because of the extreme analytic complexity inherent in multi-echelon modeling, closed-form solutions to the problem are impractical for implementation. Therefore, most models in use today rely on analytic, highly structured, solution techniques primarily through mathematical programming.

Another characteristic common to many multi-echelon models is their assumption that reordering is done on a one-for-one basis, and that an echelon may only be resupplied from a higher level (i.e., no lateral resupply). As in any modeling effort, assumptions like these are made to enhance the model's tractability. However, these two

particular assumptions are clearly violated in real world practice. In general, reordering is done with economic order quantities of some sort, and critical equipment failures will invariably result in lateral resupply if necessary and feasible. The effect of these assumptions has not been made clear in the literature.

The relative merits and limitations of multi-echelon models versus 'conventional' single echelon models is not at issue in this paper. However, the following points deserve consideration. One characteristic common to these models that has limited their use to isolated cases rather than full scale adaptation, is their requirement for a detailed, and accurate data base. Generally, the data required by these models is not readily available and an entire management information system (MIS) would have to be structured and implemented to support a multi-echelon inventory model. On the other hand, these models, as a class, possess an extremely strong intuitive and analytic appeal. Not only do they integrate the supply system so as to represent the various interactions between echelons, but, they also focus management attention on the impact of a supply system on weapon systems instead of piece part support.

There has been a trend, in recent years, to emphasize the relationship between readiness and resources. These models endeavor to provide a framework from which to analyze that relationship. For this reason alone, they warrant further development, study, and investigation.

The next section discusses the measures of effectiveness used by the multi-echelon models.

C. THE OBJECTIVE FUNCTION

1. Operational Availability: Discussion

Historically, the most common measure of supply performance has been requisition effectiveness* and an associated measure of stockout risk. For a given item, it is possible to calculate the probability that the item will be available at any arbitrary time. Thus, it is possible to determine inventory levels by minimizing the total variable cost of having an item in inventory subject to a specified stockout risk, or, to solve the dual problem of minimizing stockout risk subject to a cost constraint.

Multi-echelon models, on the other hand, generally purport to measure system effectiveness vice requisition effectiveness. The most common vehicle for this measurement is operational availability (A_o). Operational availability has been defined by the following equation:

$$A_o = \frac{MTBF}{MTBF + MTTR + MLDT} \qquad (2.1)$$

where,

MTBF is mean time between failure

MTTR is mean time to repair the equipment subsequent to failure

MLDT is mean logistics delay time

In words, operational availability is, in the long run, the probability that an equipment will be available when needed. It is here that a controversy arises.

---

*Requisition effectiveness may be defined as the probability that a requisition will be satisfied when presented to a stock point activity.

This measure has been criticized for its total dependence upon mean times, which may or may not be relevant to the mission at hand. For example, assume that an equipment is to be evaluated on the basis of its operational availability where an acceptable level is 0.90. Given that the equipment has a demonstrated MTBF of 100 hours, MTTR of 1 hour, and MLDT of 9 hours, the calculated A is 0.92. The equipment would be evaluated as having an acceptable A_o. However, consider that the equipment will be used in mission scenarios which have 120 hour durations and that all failures are catastrophic and result in mission abort. The acceptability of this equipment is now open to question.

Second, one of the key assumptions made in arriving at the steady state formula given by equation 2.1, is that unlimited spares are available to effect repairs to the equipment. This seems somewhat incongruous in light of the fact that the formula is used to determine the number of spares to be allocated to achieve a stated operational availability.

Third, although equation 2.1 is the "accepted" definition of operational availability, the definition may be applied differently depending on the scenario at hand, when applied to hardware systems and their component subsystems. Kaplan presents two such cases [Ref. 2, p. 18]. In both cases it is assumed that a component failure results in system failure. Consider Case A, wherein it is also assumed that no other subsystem or component can fail when a system is down. In this case, the formula for A_o is as shown in equation 2.1, and may be calculated with the following equations:

$$A_o = \left[1 + \sum_{i=1}^{n} \frac{MTTR_i + MLDT_i}{MTBF_i} \right]^{-1} \qquad (2.2)$$

where, i represents the i-th system component.

In Case B it is assumed that component failures are not affected by the status of the system. The resultant operational availability for the system is then:

$$A_o = \prod_{i=1}^{n} \frac{MTBF_i}{MTBF_i + MTTR_i + MLDT_i} \qquad (2.3)$$

where, i represents the i-th system component.

On applying both formulas to four test problems, Kaplan found that there was no significant difference in A_o calculated by the two methods. However, inspection of the two formulas reveals the potential for significant differences.

The preceeding paragraphs are offered to demonstrate that there is a need to seriously consider and evaluate the manner in which the objectives are quantified in any given model. As a matter of practical concern, however, the operational availability measure has been, and is being used, with varying degrees of success in many applications. The following paragraphs will demonstrate its application in the three specific models mentioned previously: ACIM, Mod-METRIC, and SESAME.

2. Operational Availability: Application

Given the operational availability definition provided in equation 2.1, it is readily apparent that when holding MTBF and MTTR fixed, A_o is maximized by minimizing MLDT. Therefore, the most common form of the objective

function for a supply model is to minimize some measure of requisition delay time (e.g., time-weighted backorders) subject to a constraint on investment. There is only a very subtle difference in this regard between ACIM and Mod-METRIC, as evidenced by their objective functions which appear in Appendix A. Mod-METRIC minimizes time-weighted backorders, and ACIM minimizes time-weighted backorders per demand. Both models are constrained by investment. The SESAME model is somewhat different. The objective is to minimize total variable inventory costs (i.e., ordering and holding costs) with a constraint on the expected number of backorders. The constraint is placed in the objective function and the associated Lagrangian multiplier represents a backorder penalty cost. From the expected number of backorders, SESAME calculates the overall "average logistics downtime" and uses this calculation as the MLDT for input to the A_o formula. An explicit formulation for the SESAME objective function appears in Appendix A.

3. Other Measures

Although operational availability, or some form thereof (e.g., time-weighted backorders), is the prevalent measure of effectiveness in multi-echelon, multi-item modeling, other objectives have been proposed for use. The Air Force has shifted its emphasis in some of their more recent models, toward a measure which reflects the maximum number of sorties which are capable of being flown at any given time. Another measure which is used in a commercial multi-echelon package, OPUS, [Ref. 3], is termed "mission effectiveness", and can be thought of as a measure of system reliability. OPUS also employs other measures of effectiveness such as A_o, risk of shortage, and waiting times, in its various applications.

III. MULTI-ECHELON SIMULATION

A. INTRODUCTION

The analytic models discussed in the previous chapter generally serve to provide actual inventory levels for each echelon of supply, and the resultant 'readiness' measures associated with these levels. Multi-echelon simulations have been developed, in large part, to evaluate the sensitivity and effects of changing various parameters upon readiness. Generally, simulations are developed to represent systems and events which are too complex to analyze analytically. The analytic multi-echelon models in use today are not exact treatments; they are heuristic and, therefore, may not provide globally optimal solutions to the problems they endeavor to solve. When additional constraints and embellishments are added, even a heuristic treatment often becomes intractible.

By their nature, simulations only provide estimates to the performance measures of interest. Repeated sampling improves upon this estimate, but even with a very detailed model that is run many times, there is no guarantee that the estimate will be an accurate representation of the real world. The objective, rather, is to have the facility to compare many systems and/or policies under controlled conditions. These conditions should represent the salient characteristics of the environment in which those systems and policies will be operating.

In the next section of this chapter, four multi-echelon simulations which have been developed for, and used by the Navy are examined. In the final section, the need for another such model is established, and a new model, METEOR:

Multi-Echelon Technique for Evaluating Operational Readiness, is introduced.

B. CURRENT MODELS

1. General

Multi-echelon simulations have been developed as tools to aid in the evaluation of alternative supply policies which affect the material readiness of hardware systems. At issue may be the determination of various inventory and reorder levels, transportation methodologies, budgets or any other number of supply related parameters. In this context, the systems being supported may range from relatively simple equipments to entire fleets of ships or aircraft. In a quest to quantify its readiness posture, the U.S. Navy has sponsored and/or developed a number of readiness assessment type simulations. In general, these may be partitioned into two groups: equipment and supply. The two groups are distinguished by their measures of effectiveness which are characteristically equipment-oriented in one case and supply-oriented in the other. All models discussed are Monte Carlo, discrete event simulations.

2. Ships Supply Support Study (S4)

This simulation was developed in the early 1970's in response to a Chief of Naval Operations (CNO) call for an automated model which would relate dollar outlays to fleet capabilities. Surface forces of the Sixth Fleet form the basis and operating scenario for the model. Four echelons of supply are represented and modeled in great detail. Each discrete echelon model embodies the actual forecasting and replenishment routines that were in current use by the Navy. Each echelon, however, is treated independently of the others. They are linked together only in the final analysis

by means of a synthesizer which computes system performance statistics as a function of the output of each echelon. The output offers various measures of supply effectiveness. S4 did not model an equipment repair process or pipeline. Because of the detail modeled at each echelon, the data base required was extensive and, consequently, the model has been considered cumbersome and limiting.

3. Aviation Afloat and Ashore Allowance Analyzer (5A)

The 5A simulation was a follow-on to the S4 study. It was also sponsored by the CNO to evaluate resources and their impact on readiness. This effort shifted the scenario from a shipboard environment to the Naval aviation supply community. The 5A study modeled three echelons to reflect typical Seventh Fleet aviation resupply, transportation, and communication channels. As with the S4 study the echelons are treated independently being linked together by means of a synthesizer. Output is supply oriented and data base requirements are extensive. The individual echelon models may be used independently for analysis of problems at any particular echelon desired. A major difference between 5A and S4, is 5A's explicit treatment of repairable material and the repair pipeline.

4. SPECTRUM

Unlike the supply oriented S4 and 5A simulators, the Simulation Package for Evaluation of Carrier Techniques, Readiness, Utilization and Maintenance (SPECTRUM), is equipment and system oriented. It models an equipment's configuration in terms of its components and provides output in the form of equipment availability and reliability. It was developed under sponsorship of the Naval Air Systems Command, Readiness Improvement Office.

SPECTRUM is a highly complex, modularized, discrete event simulation designed to project readiness values for Naval airborne weapons systems as a function of their total logistics support system and operational employment. The modules are classified in two groups, PRISM and RETINA. The PRISM group simulates organizational and intermediate level maintenance and local aviation supply. RETINA simulates depot level maintenance and its associated supply and distribution network. The PRISM group consists of the following modules which can be run either independently or collectively:

IMAGE - encompasses the material, physical, personnel and procedural processes involved with aviation intermediate level maintenance

PEER - simulates removal of aircraft engines and the handling of the failed engine and its replacement.

OPTICS - simulates the effect of organizational level maintenance and supply. Includes aircraft handling, squadron manpower, supply responses, equipment reliability and operational requirements.

LASER - models and analyzes supply performance as a function of initial stock levels, demand and supply policies.

The level of detail in SPECTRUM permits studies of a very specific nature. Changes to personnel, test equipments, supply, reliability, maintainability, operating characteristics and budget constraints can be evaluated and their impact on readiness predicted.

SPECTRUM is generally considered to be a maintenance model. Technically, however, it may be considered also a multi-echelon supply model due to the fact that it models

the end use echelon which is supported by a conglomerated 'higher' echelon. However, specific requisition channels are not employed and its usefulness as a multi-echelon model is therefore limited.

5. SIMULATION OF A LOGISTICS SUPPORT SYSTEM

This simulation was developed in a research effort by the George Washington University Logistics Research Project under sponsorship of the Navy Special Projects Office. The simulation is more specific in nature than those preceding in that it deals exclusively with the Polaris weapon system. Although the simulation uses actual outfitting allowances as an input to the model, it does no configuration modeling and should therefore be considered supply oriented.

Unlike 5A and S4, however, this model recognizes the inherent dependence among supply echelons and models the supply system accordingly. The four echelons modeled include up to nine end use activites (submarines), a submarine tender, an ashore depot, and the ultimate sources of supply -- the manufacturer and repair facility. It offers three alternative modes of operation. In the first, the submarine echelon may be studied independently of the others. Second, to estimate readiness degradation as a function of time, submarines may be supported by the higher echelons for a specified time, after which all resupply from upper echelons is terminated. Third, it is possible to vary depot stocks during the simulation in an effort to simulate policies associated with the budgeting process.

C. PROPOSED MODEL: METEOR

1. Purpose and Objectives

Initially, there was but one intended purpose for the development of a new multi-echelon simulation; to provide a common framework from which to analyze and compare the various analytic models discussed in Chapter II. It was shown that those models vary in their assumptions, their structure, and their objectives, and that simulation is an acceptable vehicle for performing side-by-side comparisons of these models. Furthermore, it was demonstrated in Chapter II.C.1. that the prime objective of those models is equipment oriented. That is, they attempt to reflect the interrelationships of the components which comprise the system. Supply performance is then measured by its ability to keep the system operational. The author is unaware of any current simulation that combines both hierarchical equipment configuration data and multiple supply echelons with enough detail to accurately assess equipment readiness in a multi-echelon supply environment.

Another basic purpose for the use and development of this simulation came to light in the course of this research. The Navy does not currently have a model that will evaluate the impact of changes in supply related parameters on shipboard weapon system 'readiness'. The SPECTRUM model has a wide range of variable input parameters, including supply, and has been used successfully in the assessment of hardware system readiness. However, its lack of multi-echelon supply realism has been noted and, furthermore, the simulation is very much limited to airborne weapon system applications. In its current state, METEOR is capable of assessing weapon system readiness as a function of the system configuration, the equipment reliability, the repair process, the mission, and the logistics support

system. With the enhancements outlined in Chapter VII, this capability could be greatly expanded.

2. Type and Structure

Similar to the simulation models discussed above, METEOR is a Monte Carlo, discrete event simulation. The simulation code is written in the FORTRAN IV programming language. It has two primary units: the equipment configuration and hardware system evaluation unit, and the multi-echelon supply and supply effectiveness unit.

The first unit, equipment configuration, is named TIGER. It is the product of previous work done by the Naval Sea Systems Command (NAVSEA) Readiness Branch in 1979 [Ref. 4].

TIGER is a generic name for a family of computer programs which can be used to evaluate, by simulation, a complex system in order to estimate various readiness measures. TIGER is being used on a stand alone basis by NAVSEA to evaluate Reliability, Maintainability, Availability (RMA) performance characteristics of new ship classes [Ref. 5]. TIGER will allow virtually an unlimited range of equipment configurations to be modeled, from very broad system representations to the minute details of piece parts. A more detailed analysis of the TIGER model is provided in Chapter IV.

The second unit, multi-echelon supply (MULTE), was developed to satisfy the objectives outlined in Section 1, above. Basically, it models up to five echelons of supply, which can be varied to suit the user's scenario. It is capable of modeling up to 30 end-use activities (i.e., ships). From one to 15 ships may be positioned on the east or west coast. Requisition channels are determined by the ship's coast and its operating mode, of which there are three: (1) operations within the continental United States

(CONUS), (2) operations outside CONUS without Mobile Logistic Support Force (MLSF) support, and (3) operations outside CONUS with MLSF support. A generic repair facility and the associated repair pipeline is modeled for each coast.

The two units are combined to form METEOR. TIGER generates equipment component failures (demands) and accumulates equipment readiness statistics based on the equipment's operational status. Given a demand, MULTE will process the requirement through the supply echelons, order replacements for stock when necessary, and return a supply response time (SRT) to TIGER. The component is restored to operational status when the replacement is received and installed. A detailed analysis of METEOR, in particular the multi-echelon unit, is contained in Chapter V.

3. Advantages

METEOR is unique. There are similarities between METEOR and SPECTRUM, however, they are designed around two very different supply and maintenance networks. The Navy has no other simulations which integrate a hierarchical system configuration with a multi-echelon supply system.

METEOR has a significant capability for modeling flexibility, as will be seen in the following two chapters. The potential user has an extremely wide range of modeling options which may be employed to build a detailed scenario. Indeed, the number of user options are so great that this 'advantage' may actually be a hindrance to the uninitiated user when first attempting to exercise the simulation.

The primary advantage of METEOR, however, lies in the fact that it provides a tool that heretofore did not exist. It will allow the interested analyst to make direct comparisons and to evaluate the relative performance of analytic multi-echelon inventory models.

IV. TIGER

A. INTRODUCTION

This chapter provides an overview of the NAVSEA TIGER simulation and the modifications resulting from integrating the multi-echelon supply simulation. Excellent documentation for TIGER in its stand-alone form may be found in the TIGER Manual [Ref. 6]. TIGER was amended for use on the Naval Postgraduate School computer in 1980 by Leather [Ref. 7]. It was further modified, for application on the IBM System 3033, by O'Reilly [Ref. 8]. O'Reilly's work necessitated some minor adjustments to TIGER output to facilitate his particular application. These adjustments have been removed to keep TIGER in basically its original form. For random number generation, TIGER calls on the LLRANDOMII random number generator [Ref. 9]. The complete set of computer programs which comprise TIGER, and a comprehensive variable listing, are contained in Appendices B and D to Reference 7 respectively. Portions of the TIGER program which have been changed to implement METEOR are included in Appendix E of this thesis.

B. OPERATION

1. General

In TIGER, a string of random numbers is used to generate simulated equipment times to failure (TTF) and times to repair (TTR). Based on the system configuration of component equipments, the system 'up' and 'down' times are determined, and various readiness measures are calculated. The simulated mission is repeated a number of times. The

readiness measures are aggregated for each mission, and an average is calculated to provide a statistical estimate of the actual system performance characteristics.

Failure and repair times are drawn from exponential distributions with parameters being mean time between failure (MTBF) and mean time to repair (MTTR) for the given equipment. At the beginning of each mission, all equipments are assigned TTF's based on their MTBF's and a random draw. The TTF's are placed chronologically in an event queue. The first time to failure is accessed and the simulation clock is advanced to the corresponding event time. A TTR is generated for this equipment again, based on its assigned MTTR and a random draw. The TTR is added to the current time (and flagged to identify it as a repair time), and this new event time is placed chronologically in the event queue. This process continues until the next event time exceeds the end of mission time, at which point the current mission is terminated and a new one is started.

The number of missions to be run is determined by the user in one of two ways. In the first case, he may specify a fixed number of missions to be run (from 50-1000 in increments of 50). In the second case, the user specifies a target and lower confidence limit for the system reliability performance measure. Missions are run in increments of 50, and system reliability is computed after each increment. If the target is achieved prior to a specified number of missions, the system meets reliabiltiy requirements, and execution is terminated. If the system does not attain the lower confidence limit prior to the specified maximum number of missions, the system fails its reliability requirement, and execution is terminated.

2. Equipment Characteristics and System Configuration

The hardware system under scrutiny is divided into subsystems, and the subsystems further divided into any level necessary to depict the system in accord with the user's requirements. The lowest level identified is termed an "equipment type" and must be assigned a MTBF, MTTR, and the percent of time it will be used in the system. The most convenient method for depicting the system is to construct a reliability block diagram such as that shown in figure 4.1 . Each block in this diagram can be identified as being in either an up or down state at any given time. By tracing through the various component states, it is possible to determine the overall system status as being either 'up' or 'down'.

3. Mission Timeline

Each mission is made up of a sequence of operational phases of user specified duration that describe the mission scenario. In each phase, the equipment may be configured differently and operated under various conditions. TIGER will recognize up to six different phase types in a mission. Up to 91 phase types may be strung together in any order desired to represent the mission to be completed. For example, if the user desires to represent a mission that consists of transit, alert, and engagement phases, it would be possible for TIGER to vary the weapon system's operating mode during each phase type. This feature provides TIGER the capability for modeling complex mission scenarios.

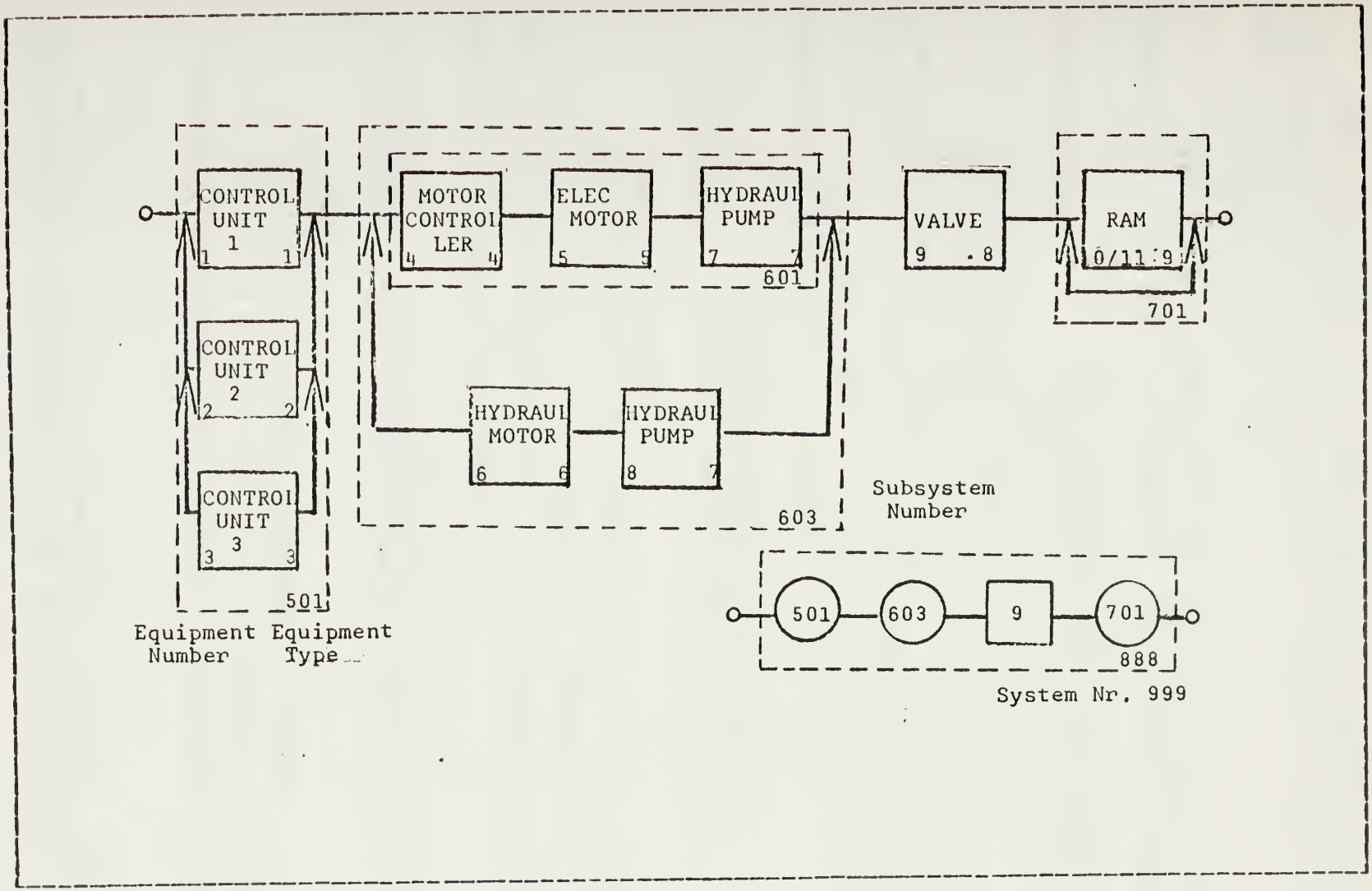

Figure 4.1 Sample Reliability Block Diagram.

C. PERFORMANCE MEASURES

Over the course of each mission, TIGER accumulates various statistics which are used to compute four performance estimators. They are:

1. Reliability

Estimated reliability is the probability that a system will perform satisfactorily for an entire mission.

$$\text{REL(Estimate)} = 1 - \frac{\text{Nr. of Mission Failures (Aborts)}}{\text{Total Nr. of Simulated Missions}} \quad (4.1)$$

2. Instantaneous Availability

Estimated instantaneous availability is one of two availability measures used in TIGER. Instantaneous availability is the probability that a system will be in an up state at a specific point in time. It is calculated at the beginning and end of each phase.*

$$\text{AVA INST (Estimate)} = \frac{\text{Number of Missions Up at Time (t)}}{\text{Total Number of Missions Simulated}} \quad (4.2)$$

3. Average Availability

Estimated average availability is the probability the system will be in an up state at a random point in time. This measure corresponds to the operational availability measure discussed in paragraph II.C.1.

$$\text{AVA AVERAGE (Estimate)} = \frac{\text{Total System Uptime}}{\text{Total Mission Time for all Simulations}} \quad (4.3)$$

4. Readiness

Estimated readiness is defined in TIGER as the probability that the system will be in satisfactory operating condition at a random point in time. Satifactory operating

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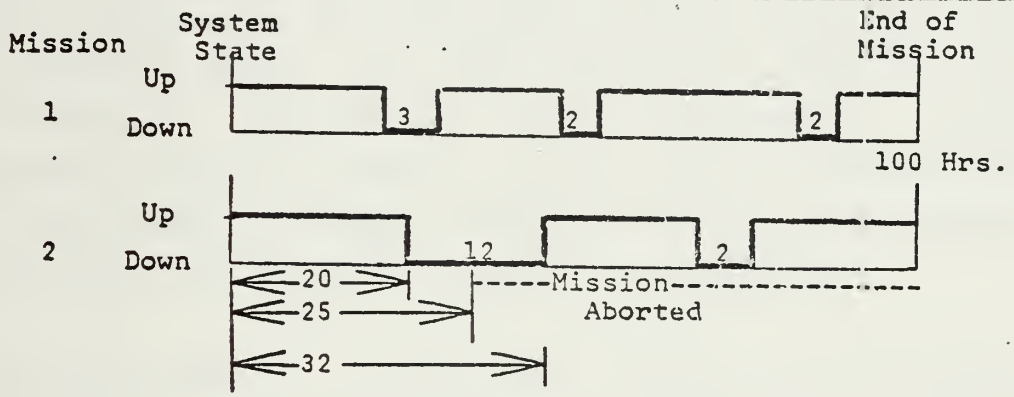
*Although one phase begins where a previous ends, the instantaneous availability value may be different if the system states are different in the two phase types.

condition is considered to be when there is neither a mission abort nor a system down. When a mission abort occurs, the system will not recover to an up state for the remainder of the mission.

$$\text{RED (Estimate)} = \frac{\text{Downtime Prior to Mission Abort} + \text{Time after Mission Abort}}{\text{Total Mission Time for all Simulations}} \quad (4.4)$$

Figure 4.2 provides sample calculations for reliabilty, availability, and readiness performance measures.



	Mission 1	Mission 2	Simulation Total
Calendar time	100	100	200
Downtime (AVA)	7	14	21
Uptime (AVA)	93	86	179
Availability	.93	.86	.895
Downtime (RED)	7	80	87
Uptime (RED)	93	20	113
Readiness	.93	.20	.565
Nr. Missions	1	1	2
Nr. Successful Missions	1	0	1
Reliability	1.0	0.0	0.5

Figure 4.2 Performance Measures: Sample Calculations.

D. OPTIONS AND SPECIAL FEATURES

TIGER has a number of user options that allow for added realism in scenario development. Some of these features have been exercised in the course of this research, while others have been held constant or suppressed. Following, are brief descriptions of the available features. The TIGER Manual should be consulted for additional details.

1) Logistic System. In its stand alone mode, TIGER allows for spares to be drawn from three levels of supply. Inventory levels and delay times for shipment from one echelon to another are input parameters. Unlimited spares is also an option. This is not to be construed as a multi-echelon supply system, as there is no interaction between echelons and no reorder capability.

2) TIGER/MANNING. A separate program is available to measure the effects of manning levels and maintenance personnel on equipment performance. This option was not used and is not included in the current simulation package.

3) Variable Duty Cycle and Variable MTTR. The variable duty cycle option allows the user to assign different MTBF's in different mission phases for the same equipment. Variable MTTR is essentially the same option for repair times.

4) MTBF and MTTR Multipliers. These options change MTBF or MTTR across the entire mission timeline and are useful in sensitivity analysis and in determining lower and upper bounds on simulation estimators.

5) Equipment Operating Rules. The user has the option, when establishing the equipment configuration for each phase, to place equipments in either an operating or standby condition. Equipments can only fail when they are operating. These rules also offer the facility to more realistically model the system, subsystems, and equipments as they would function when connected in series or parallel fashion.

6) Allowable Downtime. This option allows the system and/or subsystems to be functionally operative for a period of time even though the group has changed to a down state. During this time, if repairs are made, system performance measures will not be degraded. There are two values assigned to allowable downtime. The first applies to phase type only and controls transitions from up to down state during that phase's duration. The second is mission allowable downtime and is assigned only once during the mission. If cumulative mission downtime exceeds this value, the mission is aborted.

E. MODIFICATIONS TO TIGER

Every effort was made to minimize the number of changes to TIGER in adding the multi-echelon supply simulation. Those changes that were necessary are identified in Appendix F, the TIGER program listing. The user does have the option to exercise TIGER in its stand alone form. If this option is desired, all changes will be ignored.

V. THE MULTI-ECHELON SUPPLY SIMULATION MODEL (MULTE)

A. DESCRIPTION AND MODELING CONSIDERATIONS

The following sections outline the operating characteristics of the multi-echelon simulation subroutines that have been developed to complement TIGER. A description of various user options which may be employed in the simulation is also included.

1. Terminology

For simplicity, the system to be evaluated by TIGER is hereafter known as the "weapon system". The lowest indenture level of the weapon system, as configured by the user, will be called "equipments". If two or more equipments have exactly the same salient characteristics, they will be said to be of the same "equipment type". A series of equipments which constitute a subsystem or repair part in its own right, will be termed a "group".

2. General Operation

All equipment types in TIGER are assigned a mean time between failure (MTBF), and it is assumed that all equipments fail independently and at an exponential rate. Based on the mechanics of discrete event simulation, a failure time is initially assigned to each equipment and placed in an event queue. The first failure time is examined, a time to repair that equipment is generated, and that time is placed back in the queue. When that repair time becomes the current event, a new time to failure for the equipment is generated, and so forth.

The multi-echelon supply simulation is invoked when the time to repair a failed equipment is to be generated. The supply system must now react to provide a replacement for the failed unit.* On-hand stocks for that equipment are checked at applicable support activities in the supply network and a replacement is issued to the end user by the first activity having the part. Depending on from where the part was issued, a supply response time (SRT) will be generated and sent to TIGER. TIGER generates a random time to repair and adds to it the SRT. Statistics are then generated by TIGER, as before, to determine the availability and reliability of the weapon system based on the failure and repair if its components.

3. Scenario

The multi-echelon simulation subroutines have been developed to provide the user significant latitude in establishing the desired operating environment. Up to 30 ships may have the weapon system installed on board. The weapon system configuration need not be the same on any two ships and outfitting may also vary from ship to ship (input requirements are simplified, however, when this is not the case). Up to 15 of the 30 ships may be assigned to the east coast and up to 15 assigned to the west coast. The user determines under what conditions the ships are operating and, as a result, specifies the requisition channels to be employed. Three operating environments are recognized: CONUS operations, overseas operations with MLSF support, and overseas operations without MLSF support. Figure 5.1 summarizes the requisition channels used for each of these

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*Note the assumption that an equipment failure assumes that a replacement part is necessay to repair the failed equipment. The validity of this assumption depends upon the level of detail employed by the user in modeling the weapon system configuration.

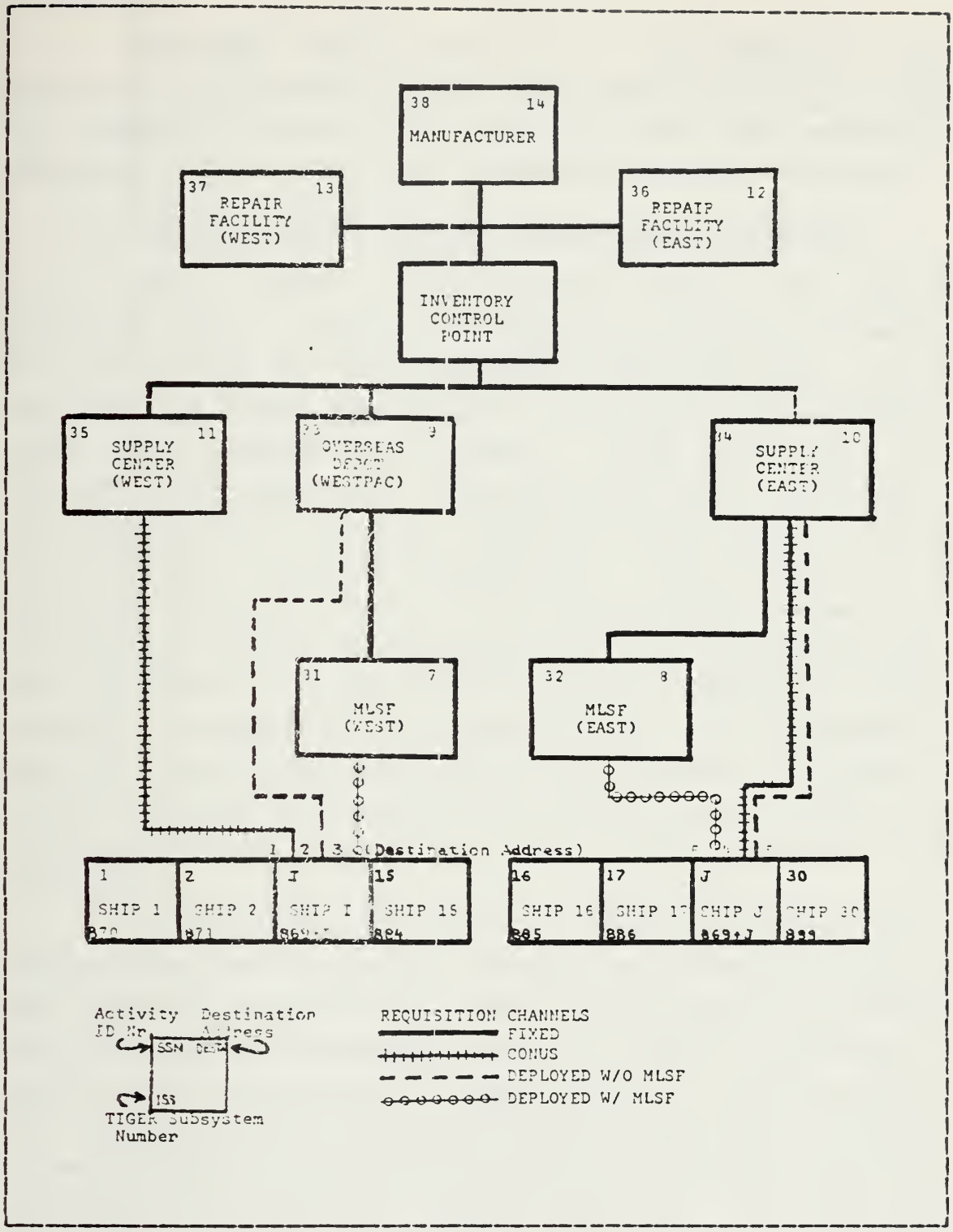

Figure 5.1 METEOR Requisition Channels.

conditions.

Although TIGER allows up to six different phase types and 91 different phases to be employed over the course of a specified mission, it should be noted that requisition channels will be fixed over the entire mission timeline.

4. Requisitioning, Issue, and Reorder Procedures

When a weapon system equipment fails, the end use activity (ship) checks to determine if spares are carried and are on-hand for that particular equipment type. If so, the part is issued from ship's stock and a user specified issue delay constant is returned to TIGER as the SRT. The end user then checks his inventory position to determine if the reorder point for that equipment type has been reached and orders for stock as appropriate. If the part was not available from ship stock, the requisition is passed to the next supply echelon in accordance with the requisition channels in effect. All other activities in the supply network operate in essentially the same manner. If no echelon is capable of providing the required replacement, an order is placed with the manufacturer for procurement. Refer to the system flowchart, Appendix D, for a more detailed process analysis.

It should be noted that the reorder process for the supply depot and two supply centers is controlled solely by the inventory control point (ICP). When the ICP's inventory position reaches the reorder point, an order is generated to either the manufacturer or repair facility as appropriate. The acquired assets are divided between the three activities (based on their current deficiencies) and shipped based on a randomized procurement or repair lead time. The lead times are generated from a gamma distribution with a user specified mean and shape parameter. As in TIGER, the times so generated are placed in an event queue. Thus, each time an

activity is called upon to check its on-hand balance, it must first look at the event queue to ascertain if any material that had been requisitioned for stock, is due in at the current time.

5. Repairable Material

In TIGER, equipment may be designated as being not-repairable during a given time frame. If so, even though an equipment fails, no repair time is established. Similarly, a user may specify a probability that repairs will not be accomplished during a given phase. These options are eliminated if the multi-echelon supply simulation is in effect, since it is unrealistic to assume that a spare would not be requisitioned simply because repairs were impeded.

The multi-echelon simulation does, however, allow the user to designate equipment as 'repairable'. These are items that are required to be turned in to a repair facility and are not authorized for shipboard repairs. When a failure of this type occurs, the end-use activity must turn in the carcass (failed unit) to a generic east or west coast repair activity. The user may specify a positive probability that carcass attrition will take place. If the failed unit arrives at the repair facility and is determined to be economically repairable (both are determinants of the attrition rate), it is held there until either the number of carcasses on-hand equals or exceeds the economic repair quantity for that equipment type, or the ICP directs a repair action to satisfy an immediate requirement.

The ICP inventory position for repairable material is decremented only when attrition occurs. Repairables are procured from the manufacturer when the number of failed units and ready-for-issue material in the system is less than the system reorder point or, to satisfy an end-use requirement when no carcasses are available for repair.

6. Priority Shipments

The multi-echelon simulation does not currently allow for prioritized shipments of critical materials. There are, however, three routines which are used to improve supply response times. They are, in order of precedence:

a) Redistribution between ICP stock points.

When a request for material is received at one of the three ICP stock point activities (i.e., depot and two supply centers) from a lower echelon, and the material is unavailable at that stock point, the ICP will redistribute assets laterally or downward through the echelons. For example, a requisition received by the east coast supply center which cannot be filled, will be passed to and filled by the west coast supply center if stock is available there. However, the ICP will not redistribute assets from the overseas depot to fill an east coast requirement since that would constitute upward redistribution.

b) Substitution due-in-for-stock item for end-use requirement.

Whenever an item is issued from a higher echelon to an end use activity to satisfy a repair requirement, an SRT is established. However, before passing the SRT back to TIGER, the end use activity's due-in-for-stock event queue will be checked to ascertain if an item for stock is due in prior to the SRT. If so, that item will be used to satisfy the repair requirement and the other will be diverted to stock.

c) Substitution of due-in-for-stock items at ICP stock point activities for lower echelon requirements.

When the stock point activities cannot produce material required by a lower echelon, the item(s) will be obtained from the manufacturer or repair facility as appropriate. If, however, an ICP controlled activity, on the requisitioner's coast, has a stock item due in and can ship it there faster than the established procurement or repair lead time, the stock item will be diverted to the lower echelon while the lower echelon's material will be sent to the supplying activity for stock.

B. INPUT REQUIREMENTS

1. General

Input requirements and formats for the TIGER simulator are well-documented in References 6 and 7. These references should be read carefully by the user prior to exercising the simulator. Significant changes to the TIGER equipment configuration data are discussed below. Noteworthy input requirements of the supply simulator are also addressed, while detailed requirements and formats for the entire input deck are contained in Appendix B.

2. TIGER Configuration Data

The TIGER simulation, by itself, models and evaluates a single weapon system. The user may configure that weapon system to virtually any desired level of detail in accordance with the provisions of reference 6. Basically, it requires the formation of equipments into "groups" that are connected in either series or parallel. The groups are connected into "subsystems" and finally, the subsystems are connected in series to form the "system".

In order to integrate the supply system and TIGER simulations, it was necessary to exploit this configuration arrangement. The TIGER subsystems become individual shipboard weapon systems in the METEOR simulation, and the TIGER "system" may be then conceptualized as a fleet-wide composite of such weapon systems. The specific subsystem/ship numbering conventions to be used in METEOR are contained in the input formats, Appendix B. Figure 5.2 depicts a typical configuration scheme which has been used in the TIGER simulation with the multi-echelon supply system option in effect. Note the subtle differences between Figure 4.1 and Figure 5.2.

3. Multi-Echelon Simulator

The potential uses of METEOR were discussed in Chaper III.C.1. The degree of detail required in the input file will be dependent on the objectives of the user.

For a real-world scenario, the multi-echelon simulator requires a relatively large and extensive input file. Ideally, METEOR would calculate provisioning levels (or stocking objectives) for each activity using various multi-echelon provisioning models as subroutines. Similarly, it would be a convenient and useful feature to have optional reorder level computations imbedded in the simulator. The level of complexity and computer storage and run time considerations however, render these options impractical at this time. It is imcumbent on the user, therefore, to obtain data from existing provisioning and replenishment models prior to exercising METEOR for these purposes.

In those cases where the user desires to assess basic supply policy alternatives or perform sensitivity analysis in regard to parameters imbedded in METEOR, it would be feasible to contrive a realistic control data set that would measure the relative merits of these alternatives

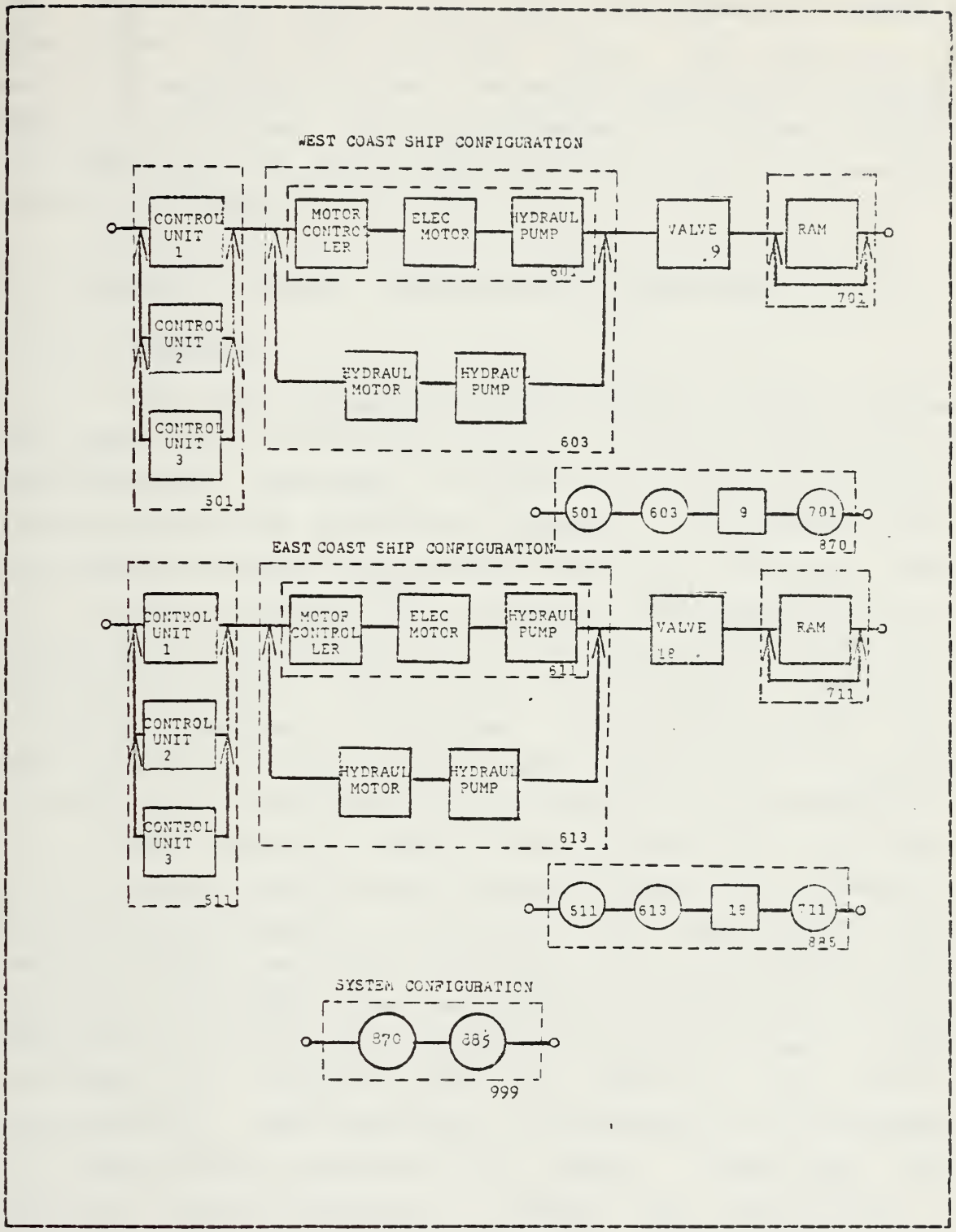

Figure 5.2 Sample Configuration Scheme.

and parameters. Data input in these cases is greatly simplified. For each equipment type, the user has the option to establish the same stocking objective and reorder point on all ships. This option serves to further simplify the input task. An example of a data input file of this type is shown in Figure B.1.

C. SIMULATION OUTPUT: STATISTICS AND SUMMARIES

1. General

The TIGER simulation offers several output options when used on a stand alone basis. The four measures of effectiveness, discussed in Chapter IV, are calculated and printed after each 50 mission increment. In addition, when the system exceeds its allowable downtime criteria, TIGER will print a mission abort message which summarizes the status of all down equipments at the time of the abort. For detailed analyses, the user has the option to review all changes to equipment, subsystem, and system status. The user will select the desired TIGER output from the options provided on the Printout Option input card (see Appendix B).

When TIGER is used in conjunction with the multi-echelon supply simulation, output format and content are altered significantly. In exploiting the equipment configuration scheme employed by TIGER, the individual ships simulated in METEOR are necessarily connected in series. Therefore, if one ship's hardware system is 'down', TIGER considers the entire fleet of ships to be 'down'. Unfortunately, this inaccuracy is reflected in all measures of effectiveness calculated by TIGER. Except for very unlikely mission scenarios, wherein all ships would be required to be fully operational for a given mission, the measures of effectiveness calculated by TIGER have little practical meaning. It is therefore recommended that only

TIGER input parameters be printed, when exercising the METEOR simulation.

Various examples of the output formats available from METEOR may be found in Appendix E.

2. Equipment Related Output

In METEOR, two of the TIGER equipment-related measures of effectiveness have been reconstructed to provide meaningful measures of equipment performance. The measures, average (operational) availability and reliability, are calculated for each ship in the simulation and then averaged across all ships to provide an aggregate measure for the weapon system under study. The two measures are calculated for the individual ships just as TIGER did for the entire system (Equations 4.1 and 4.3 refer).

To compare analytic multi-echelon inventory models, the average availability should be used as the standard since this is the measure they generally purport to optimize. As shown in the following chapter, availability is a function of time. To obtain steady state results the user must therefore ensure that the specified mission time is made suitably long.

Conversely, mission reliability is a measure which would be useful when assessing the likihood of successfully surviving a mission of specified duration. Clearly, reliability is extremely sensitive to mission length in relation to the system's mean time to failure.*

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*The user may choose to modify the reliability measure by setting the ship's system allowable downtime parameter to some value greater than zero. In so doing, the ship's system will not fail until it has exceeded the allowable downtime value. Hence, there will be fewer mission aborts, a greater likihood for mission success, and 'improved' reliability.

To evaluate the effectiveness of supply performance over time, most scenarios of interest in METEOR will incorporate relatively long mission durations. In this regard, system reliability will necessarily be driven toward zero, while average availability will tend to achieve its steady state value.

3. Supply Related Output

Detailed, event driven, supply related output is available at the user's option. Subsequent to every equipment failure, a printed summary is generated reflecting the supply system's actions resulting from the demand. This output is voluminous and, consequently, should be selected with with care. The following information is included:

- Supply Response Time. The amount of time required to satisfy the end-user's demand for material to effect repairs to the failed unit.
- Issuing Activity. Identification number** of the activity that issues the end use requirement.
- Orders For Stock. As a result of the issue, all subsequent orders for stock are displayed with the following information: ordering activity, issuing activity, and the time that the stock is due in at the ordering activity.
- Carcasses Lost Through Attrition. If the equipment that fails has been designated as a repairable item, the end use activity is required to ship the failed carcass to the nearest repair facility. If the turn-in is lost through attrition, a message will be displayed to that effect.

**A cross reference to identification numbers is provided at the end of Appendix C, Figure C.1, and is reflected in the echelon structure depicted in Figure 5.1. These references should be consulted when analyzing METEOR output.

- Repair Inductions. If the number of carcasses on hand at either repair facility is greater than or equal to the ERQ, a message will be printed, stating that an induction was initiated, to whom the items will be shipped upon completion of repair, and the time due in to the stocking activity.

Upon completion of all simulation runs, a summary analysis provides statistics pertaining to supply related costs and supply system performance. Rather than assigning arbitrary costs to supply actions, most 'costs' are given in terms of the number of actions taken vice actual dollar costs. The user may select to review the summary by supply echelon, by equipment type, or both. The following summaries are provided.

- Procurement Costs. The number of procurements per mission is given as an indication of the fixed cost of procurement at each echelon and for each equipment type. Also, the actual number of items procured is provided to reflect the variable costs associated with each order placed.
- Repair Costs. As with procurement costs, the fixed and variable costs of repair are presented in terms of the number of repair inductions and total number of items inducted. Also given is the total number of items shipped from end-use activities to repair facilities and the total number of repairable carcasses lost through attrition.
- Shipping Costs. The total number of shipments between inidvidual activities is provided as a measure of shipping activity and the costs associated therewith. Since the cost of shipping to an end use activity (ship) will vary with its location, the ships are assigned six destination addresses that are defined in Table I below.

TABLE I

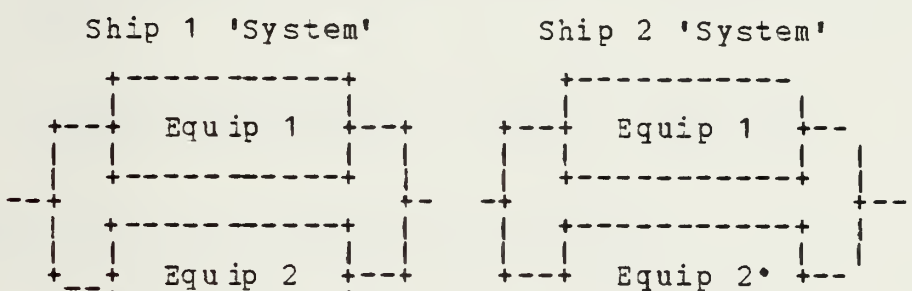
Destination Addresses

Destination Number	Ship Location
1	West Coast, Continental U.S.
2	Western Pacific, without MLSF
3	Western Pacific, with MLSF
4	East Coast, Continental U.S.
5	Atlantic/Mediterranean, without MLSF
6	Atlantic/Mediterranean, with MLSF

- Inventory costs. These costs are given in actual dollar values which are based on the equipment type costs and initial inventory levels input by the user. Two measures are displayed. First, initial provisioning costs are given to reflect the cost associated with provisioning all echelons up to their respective stocking objectives. Second, an average on-hand inventory value is calculated as a measure of inventory carrying costs. The average inventory is calculated by time weighting the inventory on-hand at each activity over the course of the simulation.
- Supply Performance. Supply performance is measured in terms of net and gross requisition effectiveness. Total demands are shown for each echelon and/or equipment type. All requisitions that cannot be satisfied are counted as not-in-stock (NIS) when the activity has an allowance for that item. If the activity has no allowance, it is counted as a not-carried (NC) demand. When the ICP redistributes assets between stock points to satisfy fleet demands, the effectivenss statistics are not affected.

VI. RESULTS

Because of the complexity inherent in a typical METEOR scenario, model validation was performed using very simple scenarios wherein it was analytically feasible to evaluate theoretical equipment performance. The scenarios were established with two ships having identical two-component



Scenario	1		2	
	MTBF	MTTR	MTBF	MTTR
Equip 1	100	12	100	9999
Equip 2	50	8	50	9999
Duration	5000		100	

Figure 6.1 Validation Scenarios.

parallel systems, as shown in figure 6.1 . Unlimited spares were available to the end-use activities and the mean logistic delay time was assumed to be zero. In the first scenario, mission duration was set to 5000 and allowable

mission downtime to zero. The intent of this scenario is to determine average operational availability over an extended mission duration. Reliability was validated under basically the same scenario, with the following exceptions. Mission duration was shortened to 100 to provide for the possibility of successful mission accomplishment; and, the equipment MTTR's were given large values (9999) to preclude repairs on the equipments during the mission. Three random number seeds were used and 100 missions were repeated for each seed.

The theoretical operational availability for this system can be expressed in terms of the following equations: [Ref. 10],

$$\text{Average Availability} = \frac{1}{T}\int_0^T A(t)\,dt \qquad (6.1)$$

From the system reliability diagram,

$$A(t) = A_1(t) + A_2(t) - A_1(t)A_2(t) \qquad (6.2)$$

Where,

$$A_i(t) = \frac{MTBF_i}{MTBF_i + MTTR_i} + \frac{MTTR_i}{MTBF_i + MTTR_i}\,EXP(-(\lambda_i+\mu_i)t) \qquad (6.3)$$

The limiting results for average availability are:

$$\text{Limiting Average Availability} = A = \lim_{T\to\infty}\frac{1}{T}\int_0^T A(t)\,dt \qquad (6.4)$$

$$= \frac{MTBF}{MTBF + MTTR} \qquad (6.5)$$

For the system under study,

$$A = A_1 + A_2 - A_1A_2 \qquad (6.6)$$

Assuming no repair will be made to the system during the mission, theoretical reliability may be computed as follows:

$$R(t) = R_1(t) + R_2(t) - R_1(t)R_2(t) \qquad (6.7)$$

Where F(t) is the survival function for the system. Assuming exponential times to failure, the survival function for an equipment is:

$$R(t) = EXP(-\lambda t) \qquad (6.8)$$

In scenario 1, theoretical availability is computed using the limiting results; equation (6.1) is used in scenario 2 due to the relatively short mission duration. A comparison of the computed and simulated values for availability and reliability is displayed in Table II .

The test results indicate that the model output closely approximates the expected theoretical values. It is recommended, in the following chapter, that further research be directed toward more extensive testing of the METEOR model to verify its performance over a wide range of possible scenarios.

TABLE II

Simulation Results

Scenario #1

Run	Seed	Availability	Reliability
1	8720	.9855	0.0
2	1353	.9861	0.0
3	4534	.9853	0.0
Theoretical Values		.9853	0.0

Scenario #2

4	7381	.7447	.4400
5	2268	.7570	.4750
6	8720	.7631	.4500
Theoretical Values		.7482	.4534

VII. SUMMARY AND RECOMMENDATIONS

A brief survey of multi-echelon models currently in use in the Department of Defense has been presented. It was shown that differences exist in their assumptions, their structure and objectives. To compare the relative merits of these models, therefore, a common frame of reference is needed to evaluate their performance over time and the costs associated with their implementation. Due to the inherent complexities of multi-echelon, multi-indenture models, an analytic comparison was regarded as impractical and simulation was suggested as a feasible alternative. To make a valid assessment of the multi-echelon, multi-indenture inventory models, a simulation with these same features is required.

Chapter III provided an overview of multi-echelon simulations currently in use by the Navy. With the possible exception of the SPECTRUM model, none of those reviewed were found to be adequate for use as a multi-echelon evaluation tool. Additionally, it was determined that no current simulation exists which offers multi-echelon, multi-indenture characteristics in a surface fleet environment. In light of these facts, a simulation model, METEOR, was developed to satisfy these needs.

METEOR is a multi-echelon supply model that incorporates a multi-indenture, equipment-related model, TIGER, to generate equipment failures and subsequent supply system demands. The METEOR model offers a wide range of possible user-developed scenarios and equipment configuration schemes. Its output consists of various measures of supply related costs and supply performance, as well as, the equipment performance measures of operational availability and reliability.

Chapter III stated that the primary motivation for building this model was to offer an evaluation tool that heretofore was unavailable. The actual use and employment of this model is left to future research. The interested student/analyst might consider the following recommendations and proposals:

1. Any new model must necessarily undergo the test of objective analysis prior to its acceptance and implementation in the field. In this regard, continued validation of the METEOR model is encouraged. Confidence in any model increases with its successful application under diverse scenarios, and when it is successfully exercised by different users. More detailed and varied scenarios than those found in Chapter IV have feasible analytic solutions which could be compared statistically to simulation results.

2. To accurately assess multi-echelon inventory models, the primary objective of METEOR, a relatively large and accurate data base is required. An actual operating hardware system should be the basis for model performance comparisons. Admittedly, a hypothetical system could be used. However, modeling an actual operating system would lend credence to the study effort and offer the historical parts related data necessary for model inputs. This data set would be the control factor in the evaluation process and provide inputs to all models under study, as well as the METEOR simulation. Each multi-echelon inventory model under consideration would need to be accessed and exercised with the control data set. The inventory levels generated by these models would serve as input to the initial provisioning levels in the METEOR simulation. The purported costs and equipment-related measures of effectiveness provided by each model should be recorded for use in the final analysis. Finally, it would be necessary to process the data through the Navy's current

repair and replenishment models to determine reorder levels and economic repair quantities. Provided with these inputs, METEOR should return an objective assessment of the relative performance of the models under study.

3. There is no reason to restrict the use of METEOR to the evaluation of multi-echelon models. In fact, the multi-echelon characteristics of METEOR make it an extremely useful tool in assessing the effect of parameter changes at any one echelon of the supply system, in that the impact of those changes will be reflected at all levels of the system.

4. METEOR might also be used as a resource-to-readiness evaluation model. The availability of investment capital is normally the binding constraint on inventory levels. By varying inventory levels at the stocking activities, a determination could be made as to the investment required to obtain a given level of material readiness. Additionally, some insight might also be gained as to which echelons offer the highest rate of return on investment.

5. In terms of model enrichment, there exist several areas where METEOR might be embellished. Some of the more important extensions would include the following.

a) Prioritized shipments for critical material.

b) Expansion of the model to allow for more than 500 total equipments to be modeled. This should be a user specified parameter.

c) Parameters that exhibit large variations from their means should be made random variables if such action would significantly enhance model realism. METEOR uses average values for order and shipping times, and, does not model geographic proximity of the ships and MLSF. Depending on user requirements, it may be considered beneficial to model these as stochastic processes.

d) In the real world, not all equipment failures necessitate replacement of component pieces. A randomized determination of whether or not parts are required to effect repairs could be made by METEOR.

6. METEOR is a relatively easy model to implement. Once the input data is prepared, it takes only 4-8 seconds of CPU time on the IBM 3033 to run 1000 missions of duration 5000 hours. This offers an excellent opportunity to explore supply system interactions and parametric sensitivity in a multi-indenture, multi-echelon environment.

APPENDIX A
EXAMPLE OBJECTIVE FUNCTIONS

The following objective functions, ACIM, Mod-METRIC, and SESAME, are reprentative of those used in other multi-echelon inventory models. For more detailed treatment, consult the cited reference.

1. Availability Centered Inventory Model (ACIM) [Ref. 11].

$$\text{MIN } D_{eu}$$

$$\text{s.t. } \sum_k \sum_v c_k s_k = B$$

where,

D_{eu} = the expected delay time for equipment e, at operating site u, and

B = Total allowable budget

k = component of e

v = unit cost of k

s = stocking level of k

D_{iu}, the expected delay per demand for item i, at stocking location v, can be expressed as:

$$\frac{1}{\lambda_{iu}} \sum_{x=s_{iu}+1} (x-s_{iu})\, p(x;\lambda_{iu},T_{iu}) \quad u=(0,1,\ldots,\ )$$

where,

λ_{iu} = Expected number of demands for item i, at operating site u.

$p(x;\lambda_{iu},T_{iu})$ = Probability of x units of stock reduction for item i, at operating site u.

T_{iu} = Mean resupply time.

2. Multi-Echelon Tehnique for Recovererable Item Control; Modified (Mod-METRIC) [Ref. 12].

$$\text{MIN} \quad \sum_{i=1}^{M} \sum_{x_i=s_i+1}^{\infty} (x_i - s_i)\, p(x_i \mid \lambda_i T_i)$$

where,

M = Total number of bases.

s_i = Stock level of spare components at base i.

T_i = Average resupply time at base i.

λ_i = Removal rate of components at base i.

s.t.

$$\sum_{i=1}^{M} (c_e s_i + \sum_{j=1}^{N} c_j s_{ij}) + \sum_{j=1}^{N} c_j s_{oj} + c_e s_o \leq C$$

where,

c_e = Cost of equipment

c_j = Unit cost of module j

N = Number of modules

s_o = Number of spare modules at depot, o

C = Total allowable budget

3. Selective Stockage for Availability, Multi-Echelon (SESAME) [Ref. 2].

$$\text{MIN} \quad \sum_{i=1}^{M} \sum_{j=1}^{E} S_{ij} \cdot N_j P_i + \sum_{i=1}^{M} \sum_{j=1}^{E} EBO_{ij} + RDT_{ij} \cdot N_j PC$$

where,

M = Total number of items

E = Total number of echelons

S_{ij} = Stock level for item i, at echelon j

N_j = Number of stocking activities at echelon j

P_i = Unit price of item i

EBO_{ij} = Expected number of backorders for item i

at echelon j

RDT_{ij} = Demand for item i, at echelon j

PC = Backorder penalty cost

APPENDIX B

METEOR INPUT REQUIREMENTS AND FORMATS

Most input requirements applicable the the TIGER portion of the METEOR simulation remain unchanged from the formats provided in the TIGER Manual. However, there are some variations in user options and file organization. To facilitate the use of METEOR, therefore, formats for the entire input file are provided below. Annotations are provided, where necessary, to reflect file structure when exercising TIGER on a stand alone basis. A sample input file is provided at the end of this appendix.

All data is entered in 80 column, card/card-image format. Data types are integer, real and alphanumeric. All integer data fields must be right justified.

Card Type 1. METEOR Option Card.

The METEOR option will indicate that the multi-echelon supply simulation is to be invoked on this run, or, that TIGER is to be run on a stand alone basis. Depending on the option selected, some of the input cards that follow will not be required. Additionally, various input parameters and option settings will vary between the two simulations. These changes will be reflected in the notes that follow the card formats.

Column	Format	Variable Name	Description
1-4	I4	IOPTM	METEOR option switch = 0 to run TIGER only = 1 to run METEOR
5-8	I4	IOPTP	METEOR print option switch for supply performance summary statistics = 1 by equipment type = 2 by supply echelon = 3 by equipment type and supply echelon
9-12	I4	IOPTP1	METEOR print option switch to invoke or suppress printed record of all supply actions = 0 to suppress = 1 to invoke
13-16	I4	IRC	Requisitioning Channels = 1 CONUS operations = 2 deployed without MLSF = 3 deployed with MLSF
17-20	I4	NRSHPS	Total number of ships to be simulated
21-24	I4	ITOTEQ	Total number of equipments to be simulated
25-28	I4	NRWSC	Number of ships assigned to the West Coast
29-35	F7.0	SSADT	Ship's system allowable downtime.

Notes:

IOPTM -If only TIGER is desired to be exercised, all other entries on card, after IOPTM, may be ignored.

IOPTP1 -The record of all supply actions can be voluminous.

IRC -See Figure 5.1 for resulting requisition channels.

SSADT -This input replaces TIGER allowable downtime parameters found on input cards 4, 18, and 19.

Card Type 2. Ship (subsystem) Identification Numbers

This card is used to relate TIGER subsystem numbers to METEOR ship numbers. It must be omitted if IOPTM is 0.

Column	Format	Variable Name	Description
1-4 5-8 9-12 Etc.	20I4	NUMSS(I)	Starting with the lowest numbered ship (i.e., 870 for west coast, 885 for east coast) and proceeding to the highest, identify all ships to be simulated. If more than 20 ships are to be simulated, follow with another card using same format.

Card Type 3. Timeline Iteration Card.

If TIGER is to be run on a stand-alone basis, it is possible to run more than one mission scenario (timeline). If METEOR is used, only one mission scenario is permissible.

Column	Format	Variable Name	Description
1-4	I4	JCC	No. of timeline variations to be run from data deck. Set JCC = 1 if exercising METEOR.
5-80	19A4	RUNID	Alphanumeric run identifier.

Notes:
JCC -If running TIGER and JCC exceeds 1, only phase type and duration card(s) must be added in the back of the data deck, followed by a blank card.

Card Type 4. Statistical Parameter Card.

This card is used to govern the number of missions to be performed in the simulation. If METEOR is used, a predefined number of missions should be run (see notes below).

Column	Format	Variable Name	Description
1-4	I4	NMAX	Maximum number of missions to be run. Should be in multiples of 50 and must not exceed 1000.
5-8	I4	NOPT	Optimal number of missions (not to exceed NMAX).
9-12	F4.0	PL	Specification requirement for reliability.
13-16	F4.0	XK	Standard deviation to be used in calculating lower control limit.
17-20	I4	ISEED	Random number seed.
21-24	I4	NPH	No. of phase types, not to exceed 6.

Notes:

NMAX -To run a predefined number of missions, set PL = 1.0, and NOPT and NMAX to the desired number of missions. It may be convenient, when running METEOR, to run less than 50 missions. If so, refer to TIGER main program line labels 210 and 540. Change '50' to the desired number of missions to be run.

XK -A value of 1.28 corresponds to a 90% lower confidence limit (assuming normality). Inconsequential when running METEOR.

Card Type 5. Phase Type and Duration Card.

Phases are the key to constructing scenarios in TIGER. Up to 6 different phase types may be specified. The phase types may be put together in a sequence of up to 95 phases which comprise the mission to be exercised. For example, normal steaming may be simulated in one phase, while combat operations are simulated in another. Equipment related para- meters may be varied, on the input cards that follow, to correspond to the type of operation modeled in any given phase. Note that requisitioning channels do not change with phase type.

Column	Format	Variable Name	Description
1-2	F2.0	XXT(1)	Phase type number for first simulation sequence.
3-10	F8.0	XXT(2)	Duration of first sequence.
11-12	F2.0	XXT(3)	Phase type number for second simulation sequence (if any).
13-20	F8.0	XXT(4)	Duration of second phase.

Note: Continue this format through card column 50, duration of fifth phase sequence (if needed). If more than five phase sequences are needed, continue on addi- tional cards using the same fields.

Card Type 6. ***** Blank Card *****

Card Type 7. Printout Option Card.

This card is used to select the output options available from TIGER.

Column	Format	Variable Name	Description
1-4	I4	KOPT	Printout option switch. = 1 for management summary. = 2 for engineering summary. = 3 for complete details, (used for debugging only) = 4 to suppress printout of input data. = 5 to specify printout using KS variables (see below). = 6 for TIGER/MANNING complete details (debugging only).

If KOPT=5, select from the following output options as needed, otherwise leave fields blank.

5-8	I4	KS(1)	= 1 Input data
9-12	I4	KS(2)	= 1 Equipment down at time of mission failure.
13-16	I4	KS(3)	= 1 Down time at end of phase.
17-20	I4	KS(4)	= 1 Abort messages.
21-24	I4	KS(5)	= 1 All events.
25-28	I4	KS(6)	= 1 ETIME matrix (debugging only).
29-32	I4	KS(7)	= 1 Not used.
33-36	I4	KS(8)	= 1 Not used.
37-40	I4	KS(9)	= 1 Not used.
41-44	I4	KS(10)	= 1 System & subsystem status.
45-48	I4	KS(11)	= 1 TIGER/MANNING debugging
49-52	I4	KS(12)	= 1 Status of all groups
53-56	I4	KS(13)	= 1 Downtime message

Note: When running METEOR, KOPT = 5, KS(1) = 1 is recommended.

Card Type 8. Phase Repair Card.

This card is used to specify the repair option in effect for each phase type.

Column	Format	Variable Name	Description
1-4	I4	IFLAG(1)	Repair option for each phase type type (up to six).
5-8	I4	IFLAG(2)	= 0 if on-board repair allowed.
9-12	I4	IFLAG(3)	= 1 if no on-board repair allowed.
			= 2 if on-board repair allowed, but failure inhibited. 13-16
I4	IFLAG(4)		
17-20	I4	IFLAG(5)	
21-24	I4	IFLAG(6)	

Notes: IFLAG = 1, will inhibit the ordering of repair parts even though an equipment has failed. This option is, therefore, not recommended when running METEOR.

Card Type 9. Repair Policy Card.

This card is used to determine the repair policy to be in effect during the simulation, by specifying the percentage of repairs to be performed at the organizational level. Additionally, the user may specify a period of time that the system may be down during the mission before the mission is aborted.

The MTBF and MTTR multipliers may be used to vary these parameters for a given simulation run and are, therefore, useful in sensitivity analysis.

Column	Format	Variable Name	Description
1-4	F4.0	REPOL	Decimal fraction of repairs to be performed aboard ship.
5-12	F8.2	TAD2	Mission allowable downtime.
13-16	F4.0	XM	MTBF multiplier.
17-20	F4.0	XT	MTTR multiplier.

Notes:

REPOL -In METEOR, the repair process is handled explicitly by designating equipments as repairable or consumable. If using METEOR, set REPOL = 1.0.

TAD2 -If using METEOR, set TAD2 = 100000.

Card Type 10. Equipment Type Cards.

All equipments in the simulation are given an equipment type number. If two or more equipments are essentially the same, (i.e, would have the same values for the eight parameters shown on this card, and would treated as the same item by the supply system) they would be designated with the same equipment type. METEOR deals exclusively with equipment types in the provisioning and replenishment of inventories at the various echelons.

One card is required for each equipment type.

Column	Format	Variable Name	Description
1-4	I4	I	Equipment type number. Should be sequentially starting with 1, not to exceed 200.
5-20	4A4	F1	Equipment type nomenclature.
21-28	F8.0	XMTBF	Mean time between failure.
29-32	F4.0	XMTTR	Mean time to repair. Proceed by a negative sign and include the variable MTTR card, if this option is desired. Non-repairable is indicated by value of 9999.
33-36	F4.0	U	Duty cycle/Utilization (non-zero decimal fraction).
37-40	F4.0	V	Administrative delay time from tender to ship.
41-44	F4.0	W	Administrative delay time from depot to ship.
45-48	I4	IUI	If a variable duty cycle (VDC) is desired, assign a sequential number (between 1 and 200) and include the VDC card following. Otherwise leave this field blank

Notes:

XMTTR -If an equipment type is given a XMTTR of 9999, it will not be ordered from the supply system in METEOR. This option, therefore, is not recommended.

V,W -Administrative delay time is not utilized in METEOR, these fields may be left blank when METEOR is being run.

Card Type 11. Variable Duty Cycle Card.

A variable duty cycle may be employed to vary the percentage of time that an equipment is utilized during a phase type. This is an optional input. If IUI on the previous card is non-zero, place this card immediately behind the type card to which it refers . A maximum of 50 VDC cards are allowed.

Column	Format	Variable Name	Description
1-4	I4	IV	VDC identifier-sequential number, same as the value of IUI on the preceding equipment type card.
5-8	F4.0	VDC(1)	Duty cycle/utilization of the equipment type during each phase type 1-6. These values override the value of U on the preceding card.
9-12	F4.0	VDC(2)	
13-16	F4.0	VDC(3)	
17-20	F4.0	VDC(4)	
21-24	F4.0	VDC(5)	
25-28	F4.0	VDC(6)	

Card Type 12. Variable Mean Time to Repair Card.

This card may be used to vary an equipment's mean time to repair between phase types. It is an optional card. If XMTTR is negative on the equipment type card, place this card behind the VDC card or Equipment Type Card as appropriate.

Column	Format	Variable Name	Description
1-4	F4.0	VMTTR(1)	MTTR values of the equipment type during each phase type 1-6. Non-repairable is indicated by 9999, but should not be so designated if METEOR is being run.
5-8	F4.0	VMTTR(2)	
9-12	F4.0	VMTTR(3)	
13-16	F4.0	VMTTR(4)	
17-20	F4.0	VMTTR(5)	
21-24	F4.0	VMTTR(6)	

Card Type 13. ***** Blank Card *****

Card Type 14. Equipment Cards.

Equipment cards identify similar equipments to their equipment type. Their may be no more than 500 equipments in total. Starting with the first equipment type, number each equipment in sequential order starting with number 1. Continue in unbroken sequence through all equipment types.

Column	Format	Variable Name	Description
1-4	I4	NTYPE	The Type Number associated with the equipment listed in the next field(s).
5-8	I4	LOAD(1)	Equipment numbers of those equipments which belong to the designated equipment type. Up to 19 may be designated per card. If more than 19 are associated with a given type, use additional equipment cards and repeat the same type number.
9-12	I4	LOAD(2)	
13-16	I4	LOAD(3)	
17-20	I4	LOAD(4)	
21-24	I4	LOAD(5)	
25-28	I4	LOAD(6)	
29-32	I4	LOAD(7)	
33-36	I4	LOAD(8)	
37-40	I4	LOAD(9)	
and so on to		LOAD(19)	

Card Type 15. ***** Blank Card *****

Card Type 16. Spare Option Card.

There are four options available to input spares into the simulation:

(1) If METEOR is being exercised, spares will be input in the MULTE input section, and this card must be omitted. If TIGER is being used in its stand-alone mode, the following three options apply.

(2) Use the literal "Unlimited Spares" in columns 1-16 to simulate unlimited spares (90,000 spares are internally assigned to each equipment type).

(3) If spares are to be input by the user, leave this card blank and enter spares data in the cards that follow. If a spare part sensitivity analysis is desired, enter a spare parts multiplier (SX) in columns 21-24 of this card. The multiplier will increase or decrease (depending on the value assigned) the spare parts levels that are specified on on the following cards.

(4) Enter "999" in card columns 21-24 to invoke the SPARES subprogram. This will determine levels based on the calculations of the .25 FLSIP COSAL Model.

Card Type 17. Spares Card.

If METEOR is being exercised, this card must be omitted. For TIGER, these cards are only used if the allowances for spares are the be input directly (i.e., the previous card did not specify unlimited spares or invoke the SPARES subprogram). One card must be input for each equipment type.

Column	Format	Variable Name	Description
1-4	I4	ISPARE(1)	Number of organizational level spares for the equipment type.
5-8	I4	ISPARE(2)	Number of spares at the tender for the equipment type.
9-12	I4	ISPARE(3)	Number of spares at the depot for the equipment type.

Card Type 18. System Card.

Card types 19-23 govern the hardware system configuration. Since that configuration may change from phase type to phase type, one complete set of these cards for each phase type must be placed sequentially in the data deck. An example of a reliability block diagram for METEOR appears in Figure 5.2. Starting with the individual components, groups are formed from subsets of components which are connected in either series or parallel. The groups are nested and combined with other equipments to form new groups. This process continues for each ship being simulated, until the hardware system on each ship can be represented by a single group. This group is called a 'subsystem' by TIGER. The individual subsystems (ships), are then combined in 'series' to form the overall 'system'.

Column	Format	Variable Name	Description
1-4	A4	ID	Any alphanumeric (i.e., the literal "FLT") used to identify the overall system.
5-8	I4	LL	Phase type number (sequential), from 1-6.
9-12	I4	NSS	Number of subsystems (ships) in the phase.
13-16	I4	ISS	System identification number. (Usually the last group number on the configuration matrix cards.)
17-24	F8.0	SSTIME	System allowable sustained downtime (should not be less than subsystem allowable downtime values). Should be less than or equal to TAD2 (Repair Policy Card). To inhibit aborts, use 100000.

Notes:

NSS -In METEOR, the number of subsystems (ships) must remain constant for each phase type.

SSTIME -Because ships are configured in series in METEOR, system allowable downtime has little meaning. The system would be considered 'down' anytime one or more of the invidual ship's system was down. Therefore, SSTIME should be set to 100000.

Card Type 19. Subsystem Cards.

There must be one subsystem card for each ship/subsystem, being simulated. At least one ship or subsystem is required.

Column	Format	Variable Name	Description
1-4	A4	ID	Any alphanumeric (e.g., the "SHP 1").
5-8	I4	LL	Phase type number.
13-16	I4	ISS	Subsystem identification number. This will be a group number from a Configuration Matrix Card that follows.
17-24	F8.0	SSTIME(2)	Subsystem allowable sustained downtime. This value should be less than or equal to SSTIME on the System Card. To inhibit aborts, use a value of 100000.

Notes:

ISS -In METEOR, the ISS for ships must assigned sequentially, running from 870 to 884, for West Coast ships; from 885 to 899, for East Coast ships.

SSTIME -This downtime parameter will impact reliability and availability measures when METEOR is in use since all ships will not function is another is down. Set this value to 100000, and use the variable SSADT on card type 1, if an allowable downtime is desired.

Card Type 20. Equipment/Subsystem Cross Reference Card.
This card is required in METEOR to identify on which ship the equipment failure ocurred. If IOPTM = 0, omit this card, otherwise one set will be required for each phase type.

Column	Format	Variable Name	Description
1-4	I4	NSSEQ(1)	Order ship numbers (ISS) from lowest to highest and assign each
5-8	I4	NSSEQ(2)	a sequential number starting with 1. Assign that number to NSSEQ(i), if
9-12	I4	NSSEQ(3)	equipment number 'i' is installed on that ship.
13-16	I4	NSSEQ(4)	If more than 18 equipments are modeled, use as many cards as
17-20	I4 Etc.	NSSEQ(5)	necessary in the same format.

Card Type 21. Configuration Matrix Cards.
These cards define the reliability block diagram configuration of the system under evaluation.

Column	Format	Variable Name	Description
1-4	I4	NRO	The number of members in the group defined on this card that are required to be operating for the system to be operational.
5-8	I4	IB(1)	The group number assigned to the group of members defined on this card. It may vary from 501 to 1000, in any order.
9-12	I4	IB(2)	The numbers of the equipments and
13-16	I4	IB(3)	groups which make up the group de-
17-20	I4	IB(4)	fined on this card. The maximum
21-24	I4	IB(5)	number of members in a group is
25-28	I4	IB(6)	unlimited; however, if there are more
29-32	I4	IB(7)	than 7, a continuation card is
33-36	I4	IB(8)	required, which is of the same format. The number required and master group number must be identical on all continuation cards.

Card Type 22. Equipment Operating Rule Cards.

These cards indicate the equipment operating rules for string or standby equipment. The string equipment operating rules cause shutdown of a designated series equipment upon failure of any of the other equipment or equipment groups on the card. The standby equipment operating rule, causes designated equipment to be energized upon failure of any of the other equipment of equipment groups on the card. This is an opticnal card which is placed immediately behind the Configuration Matrix Card which refers to the equipment and groups on this card. The maximum number of equipment operating rules is 49. (One rule defined per card.)

Column	Format	Variable Name	Description
1-4	I4	ISTB(1)	The designated equipment number. If it is a standby equipment, it must be preceded by a minus sign.
5-8	I4	ISTB(2)	The other equipment or equipment group numbers.
9-12	I4	ISTB(3)	
13-16	I4	ISTB(4)	
17-20	I4	ISTB(5)	
21-24	I4	ISTB(6)	
25-28	I4	ISTB(7)	
29-32	I4	ISTB(8)	
33-36	I4	ISTB(9)	
37-40	I4	ISTB(10)	
41-44	I4	IRULE	Place any non-zero integer in this field (to distinguish Equipment Operating Cards from Configuration Cards.

Card Type 23. ***** Blank Card *****

Card Type 24. METEOR Parameter Card

This card, and those that follow, are only required if the METEOR simulation option is in effect.

Column	Format	Variable Name	Description
1-5	I5	M1	Input option. = 1. If this option is selected supply input data for only one ship is required. All other ships will be configured with the same stocking objectives and reorder points. = 2. If this option is selected supply input data must be input separately for each ship.
6-15	F10.0	CRAR	Carcass return attrition rate. Enter decimal fraction of repairable carcasses that are lost due to attrition.
16-25	F10.0	MSDT	MLSF screening delay time. Enter the time required to process a NIS requisition through the MLSF, and refer the requisition to the next echelon.
26-35	F10.0	SSRT	The amount of time required to issue an item from shipboard stocks.
36-45	F10.0	ALFA1	Gamma distribution shape parameter for repairable item turnaround time.
46-55	F10.0	ALFA2	Gamma distribution shape parameter for procurement lead times.

Card Type 25. Supply Information Card.

The following 4 card types input supply related information for each equipment type. One set of these cards is required for each equipment type when M1 = 1. When M1 = 2, the set will consist of only card types 25 and 26.

Column	Format	Variable Name	Description
1-10	I10	RPAIR	Repair Code. = 0 Consumable items. = 1 Repairable items. Cannot be repaired at organizational level. Upon failure, will be shipped to nearest repair facility.
11-20	F10.0	MPLT	Mean procurement lead time for this equipment.
21-30	F10.0	ECCST	Cost per item for this equipment type.

Card Type 26. Repairable Item Information Card.

This card will be placed immediately behind the supply information card whenever RPAIR = 1.

Column	Format	Variable Name	Description
1-10	F10.0	MRT	Mean repair turnaround time for this equipment type.
11-20	I10	ERQ	Economic repair quantity for the repair facilities. When their on-hand balance of carcasses equals or exceeds ERQ an induction will be initiated.

Card Type 27. High Limit Card. (Option 1)

If M1 = 1, cards 27 and 28 are used to set activity high limits and reorder points. In this case, all ships will be given identical high limits and reorder points. If M1 = 2, these cards are omitted and cards 29 and 30 will be used to input high limits and reorder points.

Column	Format	Variable Name	Description
1-5	I5	HILIM(1)	Inventory high limit: Ships
6-10	I5	HILIM(2)	W. Coast MLSF
11-15	I5	HILIM(3)	E. Coast MLSF
16-20	I5	HILIM(4)	WESTPAC Overseas Depot
21-25	I5	HILIM(5)	E. CONUS Supply Center
26-30	I5	HILIM(6)	W. CONUS Supply Center
31-35	I5	HILIM(7)	Not Used
36-40	I5	HILIM(8)	Not Used
41-45	I5	HILIM(9)	ICP (Usually sum of HILIM(4,5,6)

Card Type 28. Reorder Point Card. (Option 1)

This card uses exactly the same format as the preceding card except the variable now is the activity's reorder point. This card will follow immediately behind Card 27.

Card Type 29. High Limit Card. (Option 2)

When read option 2 is in effect, high limits and reorder points must be individually input for all ships and activities in the simulation. Cards 29 and 30 will follow a complete set of Supply/Repairable Information Cards.

Use one High Limit Card (Option 2) for each activity in the simulation starting with the lowest numbered ship and proceding through the highest. After all ships have been entered, Enter the remainder of the activities in the following order: W.Coast MLSF; E.Coast MLSF; WESTPAC Overseas Depot; E.CONUS Supply Center; W. CONUS Supply Center; E. Repair Facility; W. Repair Facility; ICP.

Column	Format	Variable Name	Description
1-5	I5	HILIM(1)	High limit for Equipment Type 1.
6-10	I5	HILIM(2)	High limit for Equipment Type 2.
11-15	I5	HILIM(3)	High limit for Equipment Type 3.
.		Continue same format to:	
.			
76-80	I5	HILIM(16)	High limit for Equipment Type 16.

Note: Enter high limits for each equipment type in simulation. If the number of types exceeds 16, use as many cards as needed in same format.

Card Type 30. Reorder Point Card. (Option 2)

Reorder Point Cards (Option 2) follow immediately behind Card Type 28 for each activity. These cards have exactly the same format as Card Type 29 except the variable here is the activity's reorder point.

Card Type 31. Order and Shipping Time: Ship to Repair.
The following three cards refer to the shipping times between the various activities. This card inputs the time required to send a carcass from a given ship location to the nearest repair facility.

Column	Format	Variable Name	Description
			OSTSR(1-3) refers to West Coast ships sending carcasses to the West Coast repair facility.
1-7	F7.0	OSTSR(1)	Shipment time from ship in CONUS.
8-14	F7.0	OSTSR(2)	Shipment time from deployed ship without MLSF support.
15-21	F7.0	OSTSR(3)	Shipment time from deployed ship with MLSF support.
			OSTSR(4-6) refers to ships stationed on East Coast sending carcasses to East Coast (CONUS) repair facility.
22-28	F7.0	OSTSR(4)	Shipment time from ship in CONUS.
29-35	F7.0	OSTSR(5)	Shipment time from deployed ship without MLSF support.
36-42	F7.0	OSTSR(6)	Shipment time from deployed ship with MLSF support.

Card Type 32. Order and Ship Time: Manufacturer.
This card is used to input shipping times from the manufacturer to all other activities in the supply network. Note that these times are independent of procurement lead times.

Column	Format	Variable Name	Description
			From manufacturer to:
1-7	F7.0	OSTM(1)	W.Coast ship in CONUS
8-14	F7.0	OSTM(2)	W.Coast ship overseas without MLSF
15-21	F7.0	OSTM(3)	W.Coast ship overseas with MLSF
22-28	F7.0	OSTM(4)	E.Coast ship in CONUS
29-35	F7.0	OSTM(5)	E.Coast ship overseas without MLSF
36-42	F7.0	OSTM(6)	E.Coast ship overseas with MLSF
43-49	F7.0	OSTM(7)	W.Coast MLSF
50-56	F7.0	OSTM(8)	E.Coast MLSF
57-63	F7.0	OSTM(9)	WESTPAC overseas depot
64-70	F7.0	OSTM(10)	E.Coast supply center
71-77	F7.0	OSTM(11)	W.Coast supply center

Card Types 33-40. Order and Shipping Times.

A total of eight order and shipping cards will be input, each refering to a shipping activity. The entries on each card are of the exact same format as Card Type 34, and represent the order and shipping times from the shipping activity to a destination activity (as above). Note that it is clearly inappropriate for some activities to ship to others (e.g., MISF to supply center). In these cases, no entry is required. Cards must be input in the following order:

Card 33. W.Ccast MLSF
Card 34. W.Ccast overseas depot
Card 35. W.Ccast supply center
Card 36. W.Coast repair facility
Card 37. E.Ccast MLSF
Card 38. ** Blank Card **
Card 39. E.Ccast supply center
Card 40. E.Ccast repair facility

Card Type 41. Optional Output Card.

These are special TIGER options that have not been discussed in this report. They are included here for information only. For details, consult the TIGER Manual. The card may be omitted.

Column	Format	Variable Name	Description
1-4	A4	SPRS	Place any alphanumeric in this field if a table of spares usage is desired. Note: will not be printed if METEOR is being run.
5-8	A4	APPL	Place any alphanumeric in this field if a summary table of equipment that caused mission failures and system downtimes is desired.
9-12	A4	GMMA	Place any alphanumeric in this field if the gamma distribution output is desired.

Sample METEOR Input File

```
  1   3   1   3   2  22   1  0.0                          -METEOR Option Card
870 885                                                   -Ship Identification Card
  1 2-SHIP:  STEERING SYSTEM.  TEST 1/1                   -Timeline Iteration Card
100 100 1.0 1.0 8672   1                                  -Statistical Parameter Card

1. 5000.                                                  -Phase Type and Duration Card
  5   1                                                   -Printout Option Card
  0                                                       -Phase Repair Card
 1.0100000.  1.0 1.0                                      -Repair Policy Card
  1BRIDGE CONTROL      450.0 4.0  1.
  2ELECTRIC CONTROL    550.0 3.0  1.
  3LOCAL CONTROL       900.0 8.5  1.                      -Equipment
  4MOTOR CONTROLLER   1750.0 5.0  1.                         Type Cards
  5ELECTRIC MOTOR      500.0 8.0  1.
  6HYDRAULIC MOTOR     300.0 8.0  1.
  7HYDRAULIC PUMP      300.019.5  1.
  8VALVE              4500.024.0  1.
  9RAM                1000.050.0  1.

  1   1   2
  2   3   4
  3   5   6
  4   7   8                                               -Equipment Cards
  5   9  10
  6  11  12
  7  13  14  15  16
  8  17  18
  9  19  20  21  22

FLT    1   2 999100000.                                   -System Card
SHP 1  1     870100000.                                   -Subsystem Cards
SHP 2  1     885100000.
  1   2   1   2   1   2   1   2   1   2   1   2   1   1   2   2   1   2
  1   1   2   2                                           -Equipment/Subsystem
                                                             Crossreference Card
```

Sample Input File (con't)

```
  1 501    1    3    5
 -5   1    3                    1
  3 601    7    9   13
  7    9   13                   1
  9    7   13                   1
 13    7    9                   1
  2 602   11   14
 11   14                        1
 14   11                        1
  1 603  601  602
 -6 601                         1
 -8 601                         1
  1 701   19   20
  4 870  501  603   17  701
  9 603                         1
 10 603                         1
 11 603                         1
  1 511    2    4    6                  -Configuration Matrix and
 -6   4    2                    1          Equipment Operating Rule
  3 611    8   10   15                       Cards
  8   10   15                   1
 10    8   15                   1
 15    8   10                   1
  2 612   12   16
 12   16                        1
 16   12                        1
  1 613  611  612
-17 611                         1
-19 611                         1
  1 711   21   22
  4 885  511  613   18  711
 20 613                         1
 21 613                         1
 22 613                         1
  2 999  870  885
```

Sample Input File (con't)

```
  1    .05          24.          12.          1.0          1.0  -METEOR Parameter
       0      2400.        500.                                      Card
  1    1      1      0      1      1      0      0      2
  0    0      0      0      0      0      0      0      1
       0        72.          50.
  2    1      1      0      1      1      0      0      2
  1    0      0      0      0      0      0      0      0
       0      500.         350.
  1    0      0      0      1      1      0      0      2
  0    0      0      0      0      0      0      0      0
       1      400.         2000.                                  -Supply Information Card
 180.                     2                                       -Repair Information Card
  0    0      0      1      1      0      0      0      2          -High LimitCard
  0    0      0      0      0      0      0      0      0          -Reorder Point Card
       0      240.         750.
  1    1      1      1      2      1      0      0      4
  0    0      0      0      0      0      0      0      2
       0      300.         1250.
  1    0      0      2      1      1      0      0      4
  0    0      0      0      0      0      0      0      1
       0      500.         999.
  0    0      0      0      0      1      0      0      1
  0    0      0      0      0      0      0      0      0
       1     2400.         2000.
 300.                     2
  1    0      0      1      1      1      0      0      3
  0    0      0      0      0      0      0      0      1
       1     4800.         9999.
 800.                     1
  1    0      0      0      0      1      0      0      1
  0    0      0      0      0      0      0      0      0
 24.    24.    24.    24.          24.    24.          -OST Manufacturer Card
 24.   500.   660.    -Card 31      450.   400.    24.    24.
 0.0    0.0   150.                 0.0    0.0    0.0    0.0
 0.0   240.   200.    Order and    0.0    0.0    0.0    0.0
 24.   480.   600.    Shipping     500.   350.    48.    0.0
 24.   480.   600.    Time.        500.   350.    48.    24.
 0.0    0.0    0.0                 0.0    0.0    0.0    0.0
 0.0    0.0    0.0   -Cards 33-40  0.0    0.0    0.0    0.0
 48.   548.   800.                 350.   400.    0.0    48.
 48.   548.   800.                 350.   400.    24.    48.
```

APPENDIX C
VARIABLES USED IN METEOR

Table III provides a description of the variables used by the MULTE unit of METEOR, its associated subprograms, and those variables inserted in TIGER that interact with MULTE. Reference 5, Appendix B, provides a similar listing for those variables unique to TIGER. Note that the FORTRAN variable naming convention is not necessarily adhered to with MULTE variables. Variable type is noted in the listing that follows.

TABLE III

Variable Listing

Variable Name	Type	Description
A	R	Random number array.
AADV(i,j)	R	Average dollar value of inventory per mission for equipment i, echelon j.
AAGTV	R	Total average dollar value of inventory.
AATDV(i)	R	Average dollar value of inventory at echelon i.
ACT	I	Activity number designatior.
ALFA1	R	Gamma distribution shape parameter (repair time).
ALFA2	R	Gamma distribution shape parameter (procurement lead time).
ASAVA	R	Average equipment availability per mission, per ship.
ASREL	R	Average equipment reliability per mission, per ship
AVASS(i)	R	Average equipment availability per mission for ship i.
COAST	I	= 1 (West); =2 (East).
CRAR	R	Carcass return attrition rate.
CTIME	R	Current time.
DELOH(i)	I	Change in on-hand qty at level i, during current call to MULTE.
DESTN	I	Shipping destination of material.
DNUM	I	Activity designator of activity with minimum due-in time.
DTIME	R	Calculated due-in time for current requisition in process.
DTOT	I	Total nr. of due-in's established for stock during current call to MULTE.
DTSS1(i)	R	Running downtime of hardware system on ship i during current phase.
DTSS2(i)	R	Running downtime of hardware system on ship i during mission.
DUEA(i)	I	Activity designator of due-in nr. i.
DUEE(i)	I	Equipment type of due-in nr. i.
DUEN	I	Total number of due-in's.

DUEQ(i)	I	Quantity due in on due-in nr. i.
DUES	I	Due in material which is available at the current time. Added to on-hand quantity.
DUET(i)	R	Due-in time on due-in nr. i.
ECH	I	Echelon: 1-MLSF; 2-Depot; 3-Center; 4-Repair; 5-ICP
ECOST(i)	R	Cost of equipment type i
ENUSE	I	End use activity designator.
EQTYP	I	Equipment type number.
ERQ(I)	I	Economic repair quantity for equipment i.
HILIM(i,j)	I	Inventory high limit at activity i, for equipment type j.
IA	I	Issuing activity.
IASRT	I	SSN of activity issuing end-use requirement.
IDUEJ(i,j)	I	i = 1 SSN of ordering activity = 2 Due-in time at ordering activity = 3 SSN of issuing activity j = Sequential number of due-in's established during current call to MULTE.
IFLAG	I	Indicator variable.
IOPTI	I	Input option.
IOPTM	I	Multi-echelon supply simulation option.
IOPTP	I	Print option.
IOPTP1	I	Print option.
IP(i,j)	I	Inventory position of activity i, for equipment type j.
IRC	I	Requisition channel indicator. = 1 CONUS operations = 2 Overseas operations without MLSF = 3 Overseas operations with MLSF
ISHIP	I	Ship (subsystem) identification number.
ISSUE	I	Issue quantity for this requisition.
ITEMA	I	Activity number.
ITEMP	I	Temporary variable.
ITEMQ	I	Quantity required.
ITEMSS(i)	I	Indicates if current mission has been aborted for ship i. = 0 (no); = 1 (yes).
ITMSN	I	Total nr. of missions run.
IX_	I	Random number seeds.
IXD(i,j)	I	Initial provisioning level for equipment

		i, at echelon j.
K	I	Counter.
KEQ	I	Failed component (passed from TIGER).
KM1	I	K minus 1
KR	I	Counter
L	I	Counter
LEQNR(i)	I	Last equipment nr. on ship i.
LEVEL(i)	I	= 1 (Ship) when, SSN i = 1-30 2 (MLSF) = 31-32 3 (Depot) = 33 4 (Center) = 34-35
MAXD	I	Maximum due-in vector size (1000).
MAXEQ	I	Maximum nr of equipment types (200).
MAXSS	I	Maximum nr of sybsystems.
MFLAG	I	Signals start of new mission.
MIN	R	Minimum (Due-in time + OST).
MPLT(i)	R	Mean procurement lead time equipment i.
MRT(i)	R	Mean repair time equipment i.
MSD	R	MLSF screening delay.
MSDT	R	MLSF screening delay time.
MULTC	I	Nr. of calls to MULTE.
N	I	Temporary variable for ORACT(1).
NEED	I	Stock point ieficiencies for repairables.
NISS(i)	I	Nr. of issues of ship stock for equipment i.
NIST*	I	Total nr. of issues from ship stock.
NMFR(i,j,k)	I	Nr. of equipments, i, procured from manufacturer for level j; where, k = 1 Nr. of procurement actions k = 2 Nr. of items procured
NMFE(i,k)*	I	Nr. of equipments, i, procured from mfr. K as above.
NMFL(j,k)*	I	Nr. of equipments procured from mfr for level j. K as above.
NMFT(k)*	I	Total nr. equipments procured. K as above.
NNN(i,j,k)*	I	Nr. of demands at i, for equip j; where, k = 1 Total number of demands k = 2 Number NIS demands k = 3 Number Not Carried demands
NNNE(j,k)*	I	Nr. of demands for equipment j. K as above.
NNNL(i,k)*	I	Nr. of demands at level i. K as above.

NNNT(K)*	I	Total nr. of demands. K as above.
NRA*	I	Total nr. of carcasses lost through attrition.
NRF(i,j,k)	I	Nr. of equip, i, inducted by repair facilities for level j; where, k = 1 Nr. of inductions k = 2 Nr. of items repaired
NRFE(j,k)*	I	Nr. equipments inducted by repari facilities for level j. K as above.
NRFL(I,K)*	I	Nr. equipments, i, inducted by repair facilities. K as above.
NFRT(K)*	I	Total nr. equipments inducted for repair. K as above.
NRRT*	I	Total nr. items turned in to repair facility.
NRSHPS	I	Total nr. of ships in simulation.
NSHIP(i,j)*	I	Nr. of shipments from i to j.
NSPT*	I	Total nr. of shipments during mission.
NTY	I	Nr. of equipment types being simulated.
NUMSS(i)	I	Ship (subsystem) nr. of ship i.
ONHND(i,j)	I	On-hand quantity of equipment type j, at activity i.
OQICP	I	System stock deficiency at ICP.
OQREQ(i)	I	Stock deficiencies at ICP stock points.
ORACT(i)	I	SSN of ordering activity, requisition i.
ORDER(i)	I	Order quantity for stock at ICP stock points.
ORDQT(i)	I	Order quantity on requisition i.
OST__	R	(See below).
OTIME	R	CTIME of last call to MULTE.
PLT	R	Procurement lead time.
QTYD	I	Quantity due.
RELSS(i)	R	Average equipment reliability for ship i per mission.
REORD(i,j)	I	Reorder level for activity i, equipment j.
REQN	I	Nr. of requisitions currently in system.
RESON(i)	I	=1 - end use; =2 - stock, for requisition i.
RORD	I	Quantity to be repaired.
RP	I	Issuing repair facility.
RPAIR(i)	I	For equipment i, = 1 - repairable equipment = 2 - consumable equipment
RTIME	R	Repair time.

SHIPR	I	Shipping activities address.
SHPR1	I	Shipping activities address.
SHPR	I	SSN of activity whose stock due-in is diverted to fill end use requirement.
SHLOC	I	Ship location (see beclw).
SRT	R	Supply response time.
SRT1	R	Temp holding variable for SRT.
SSADT	R	Ship's continuous allowable downtime.
SSN	I	Activity identification nmuber (see below).
SSRT	R	Ship supply response time (time required to fill own requisition from shipboard stock).
ST	R	Shipping time.
SUMXD(i,j)	R	Current on-hand inventory level for equipment i, at echelon j.
T	R	Due-in time plus OST.
TO	I	Level of requisitioning activity.
TOTAVA	R	Summation of shipboard availabilities.
TOTREL	R	Summation of shipboard reliabilities.
TPM	R	Time per mission.
TMSN	R	Real value for total nr. of missions.
UP4SS(i)	R	Total system uptime for ship i.
XCUMSS(i)	R	Total number of successful missions for ship i.
XD(i,j)	R	Initial inventory investment for equipment type i, at echelon j.
XT(i)	R	Initial inventory investment at echelon i.
XG	R	Initial inventory investment.

* Indicates that when this variable is preceeded by an 'A', it represents an average value based on the total nr. of missions run.

Explanatory Notes

The configuration requirements of TIGER, require each subsystem (ship) be assigned a unique number. MULTE will require that ship's on the West Coast be assigned numbers 870-884, and those on the East Coast 885-899. A corresponding SSN (1-30) will be assigned internally to each ship. SSN's 31-38 are assigned to each of the other activities in the supply network.

Each ship is assigned a ship location based on its coast and the requisition channels assigned by IRC. The ship's location will determine which order and shipping time is to be used. There are three order and shipping time variables.

OSTSR(i) From ship location i, to repair facility on corresponding coast.

OSTM(i) From manufacturer to location i.

OST(i,j,k) From coast i, echelon k, to location j.
where, k = 1 - MLSF
k = 2 - Depot
k = 3 - Center
k = 4 - Manufacturer

Table IV displays the various designators assigned to activities in MULTE.

TABLE IV

Activity Designators

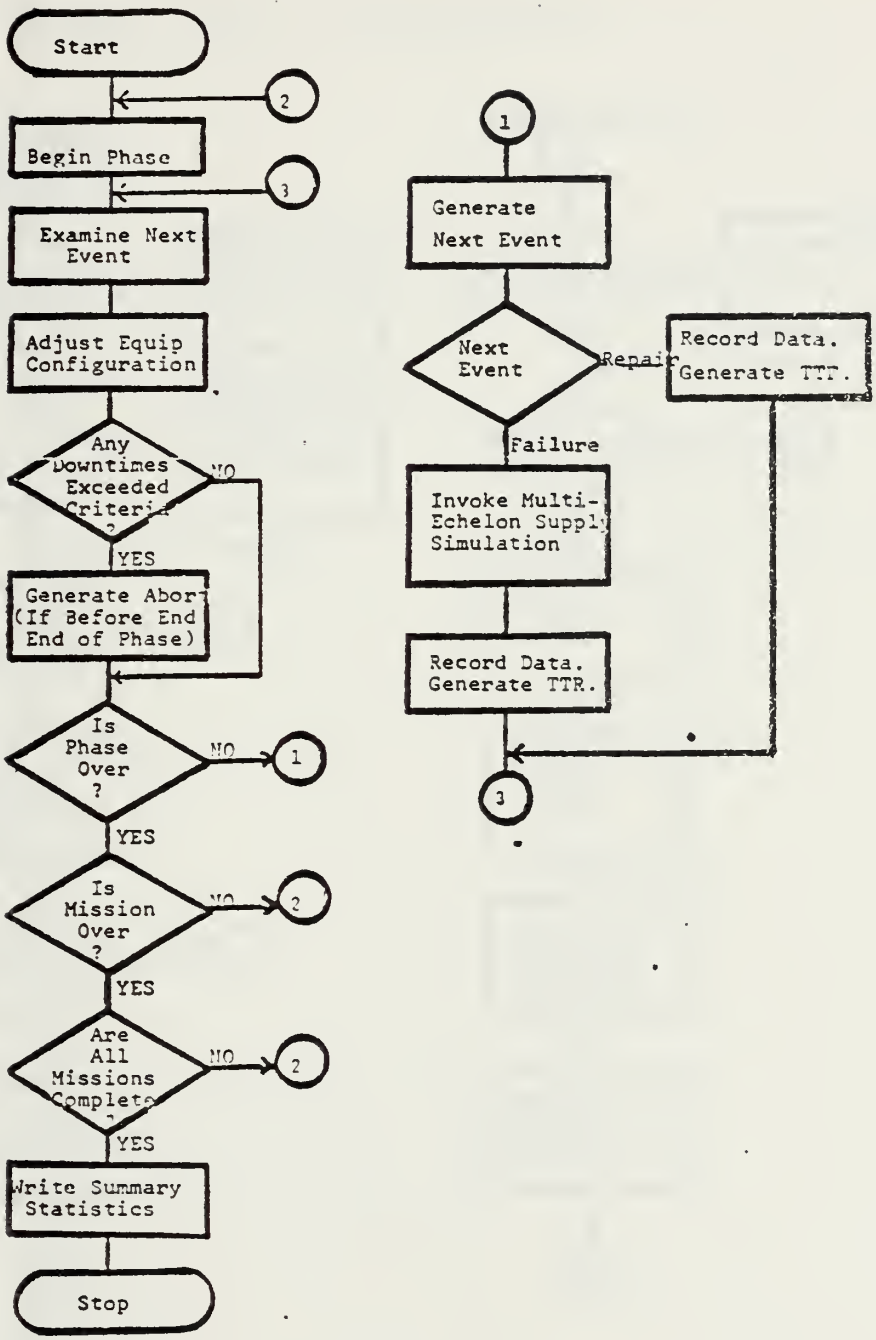
Activity	Designator				
	ISHIP	SSN	DESTN	LEVEL	ECHELON
West coast ships	870-884	1-15	1-3	1	-
East coast ships	885-899	16-30	4-6	1	-
MLSF:					
West	-	31	7	2	1
East	-	32	8	2	1
Depot (West)	-	33	9	3	2
Supply centers:					
East	-	34	10	4	3
West	-	35	11	4	3
Repair facility:					
East	-	36	12	-	-
West	-	37	13	-	-
Manufacturer	-	38	14	-	-

APPENDIX D

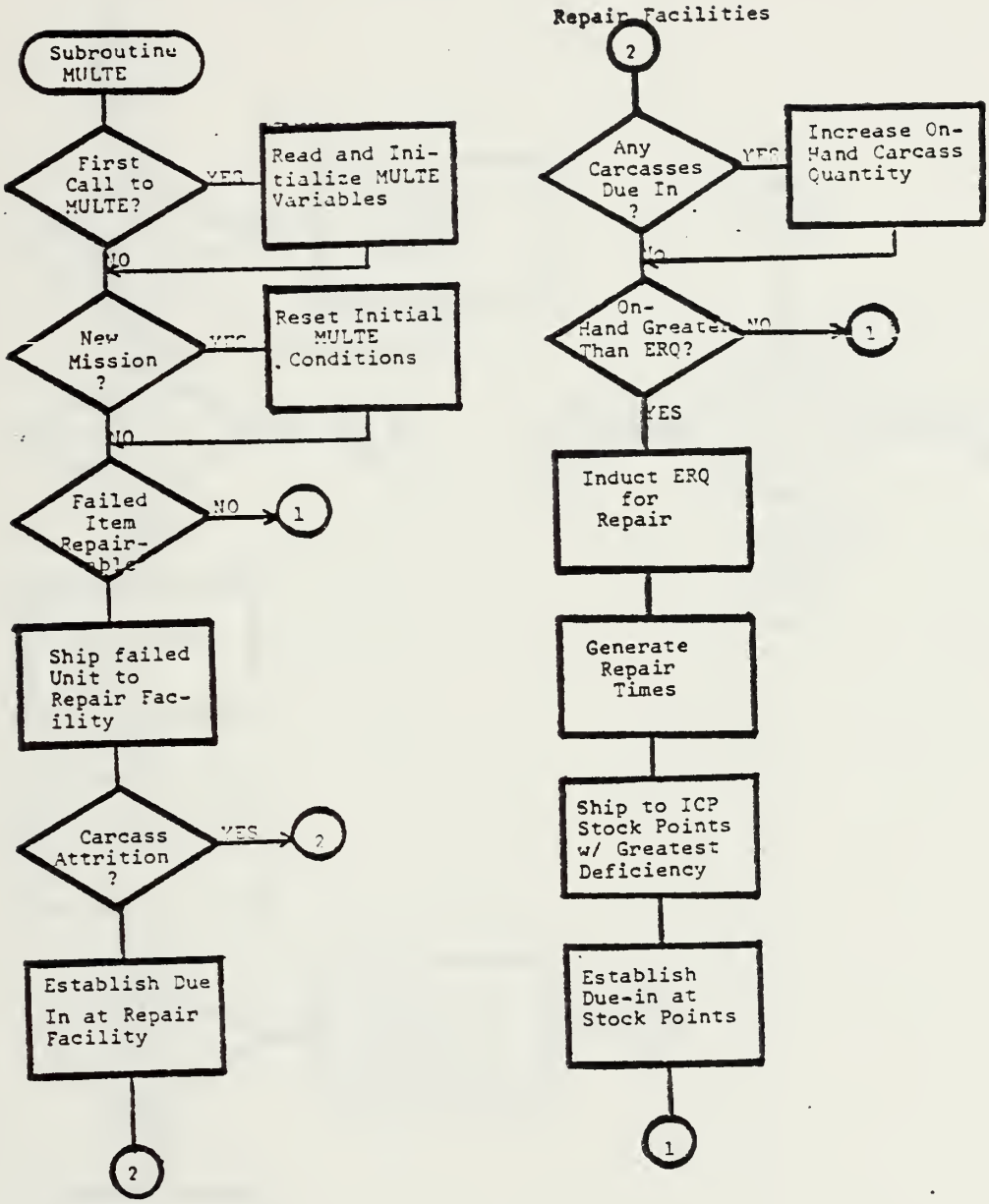
METEOR/MULTE PROCESS FLOW CHART

The process flow charts which follow are provided as an aid to the potential user in understanding how the multi-echelon supply system has been modeled. A similar flow chart for the TIGER portion of METEOR can be found in the TIGER Manual (page A3).

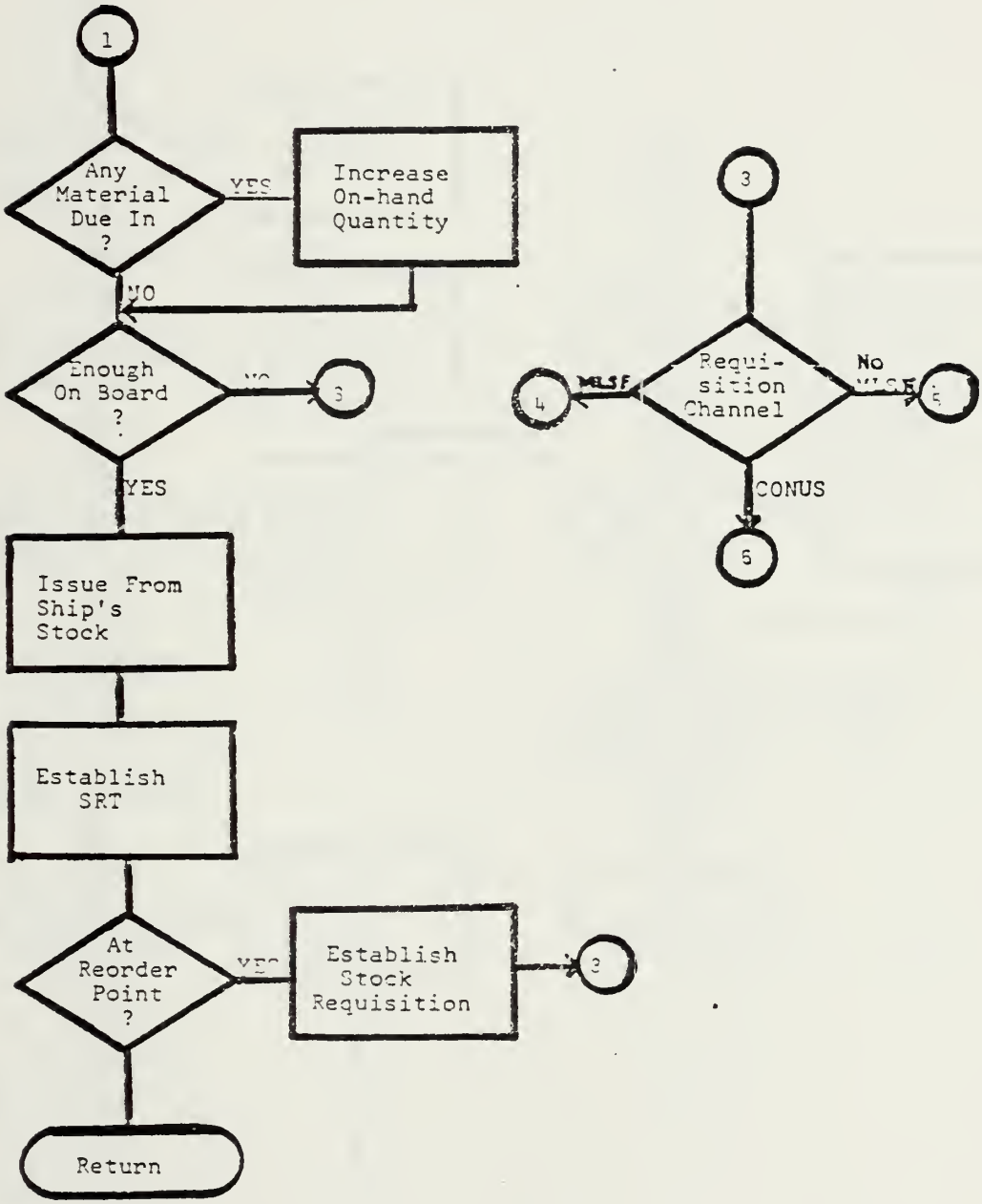
Flowchart: METEOR



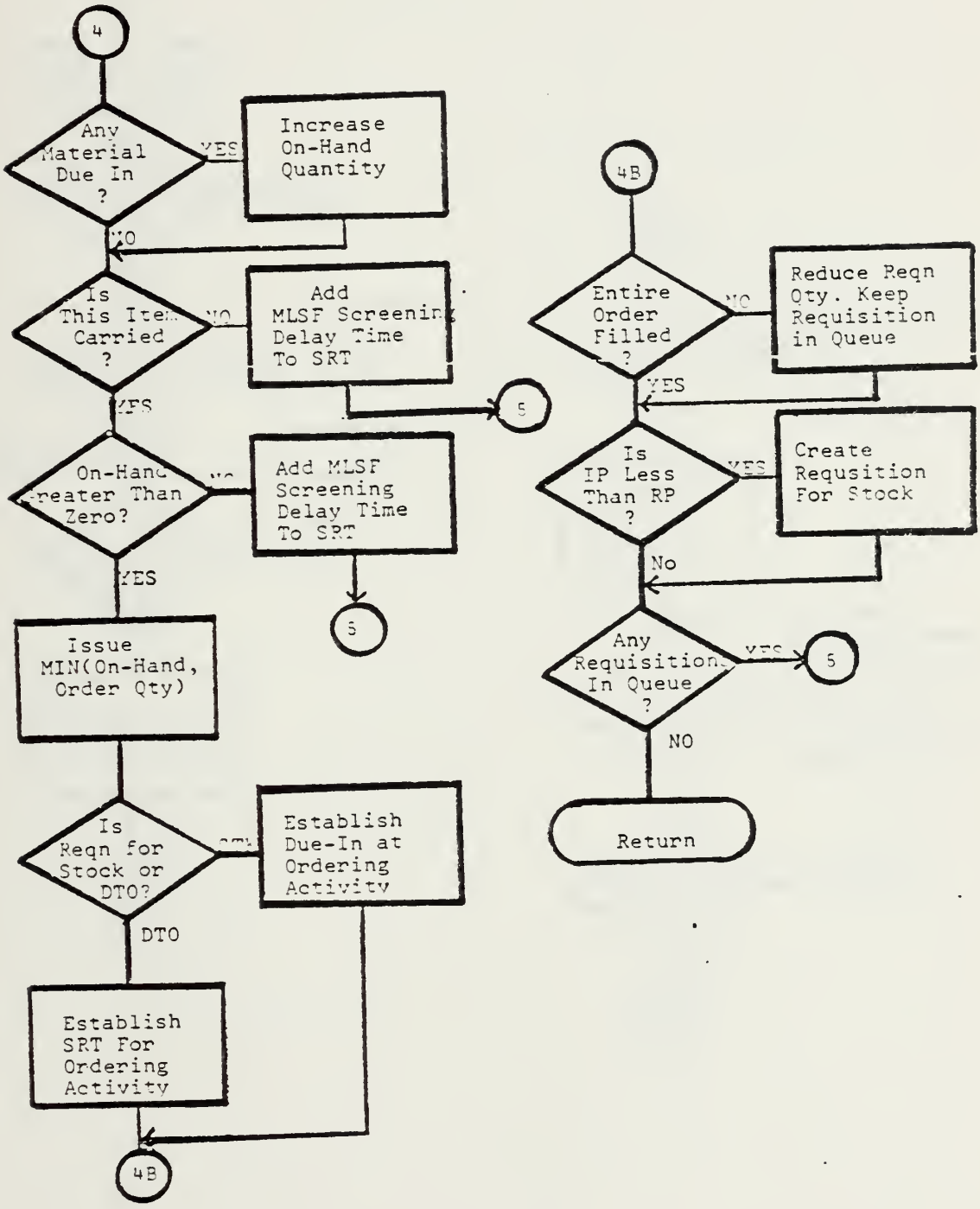
Flowchart: MULTE Initialization



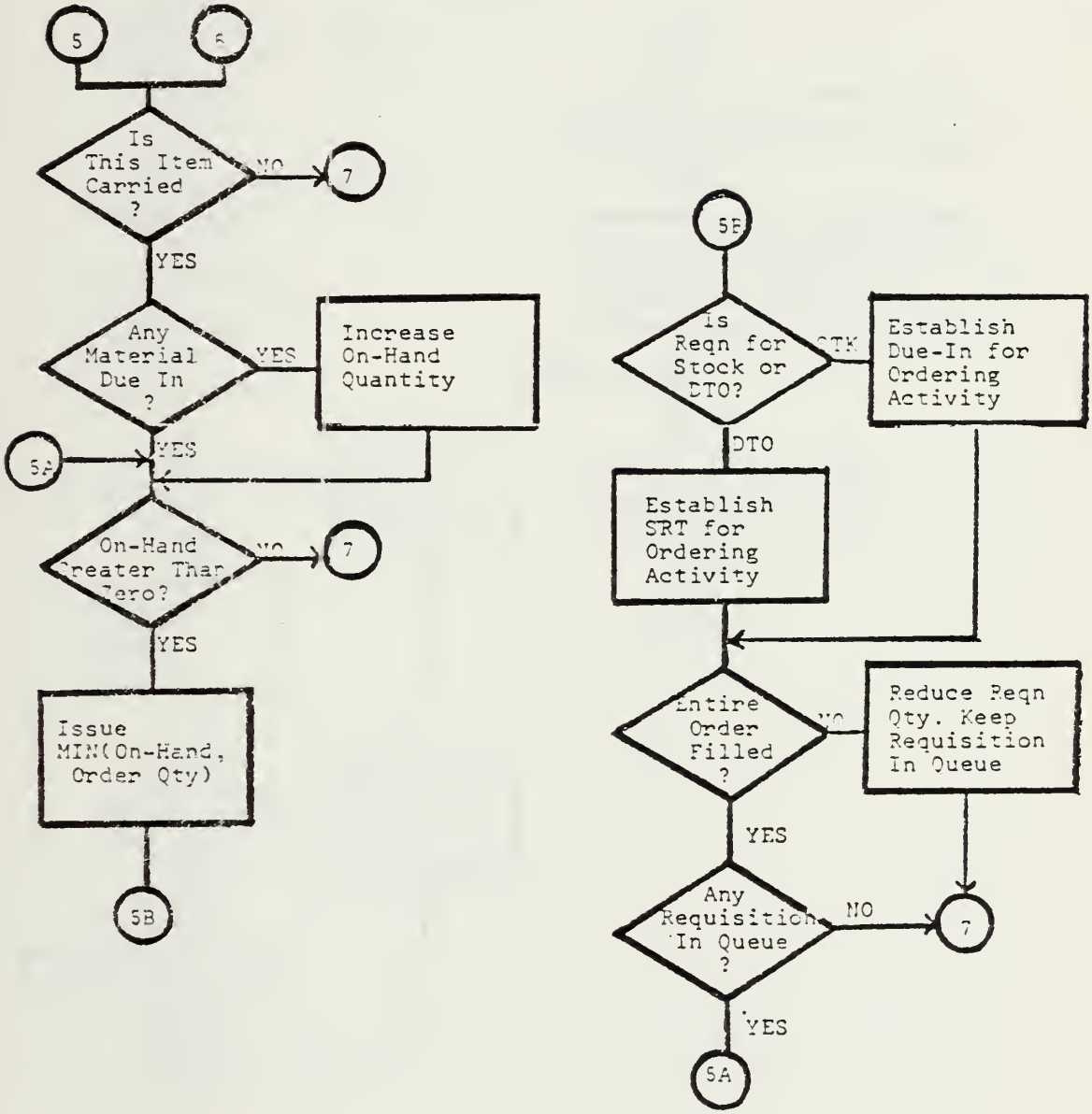
Flowchart: Ship Issue and Reorder Process



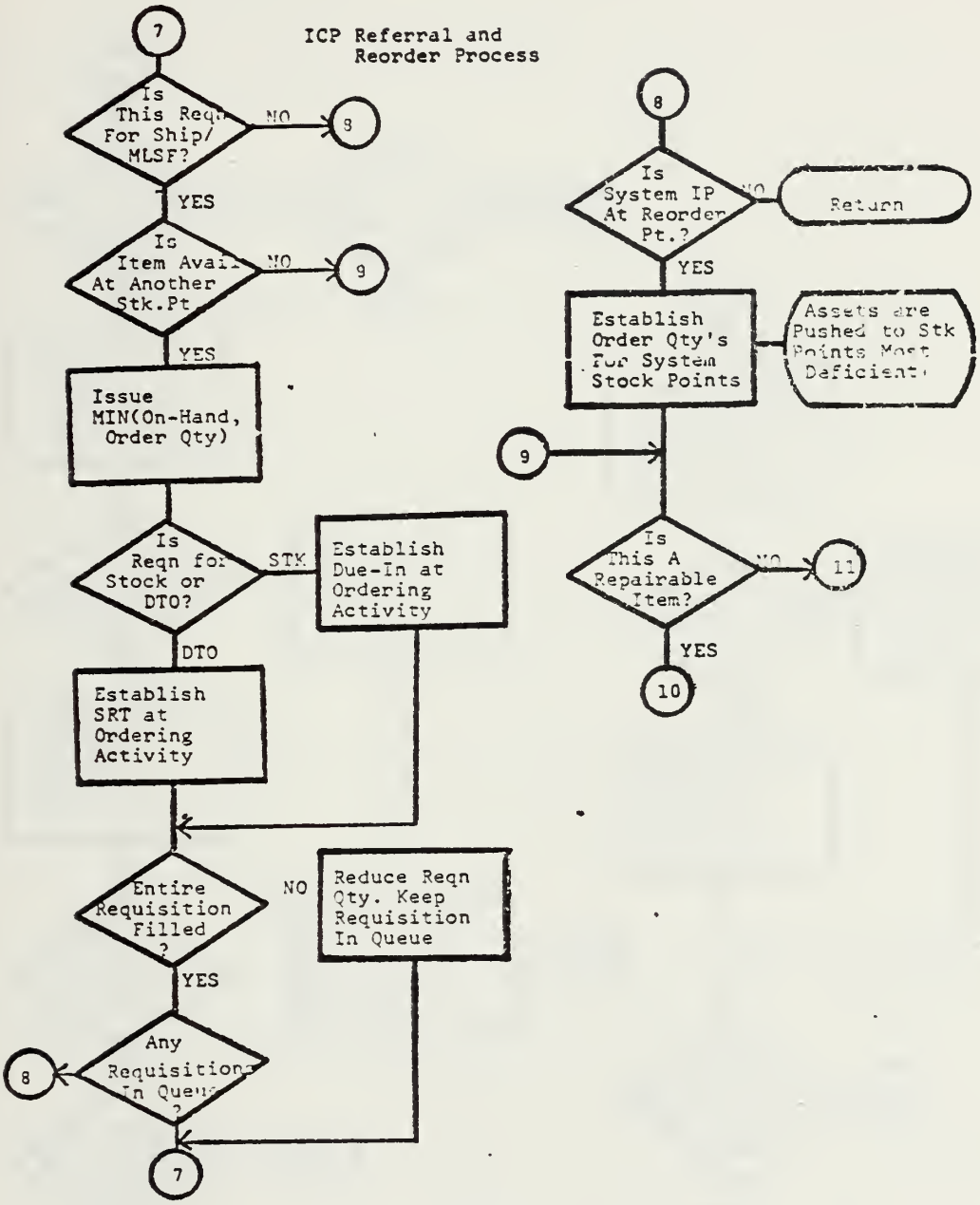
Flowchart: MLSF Issue and Reorder Process



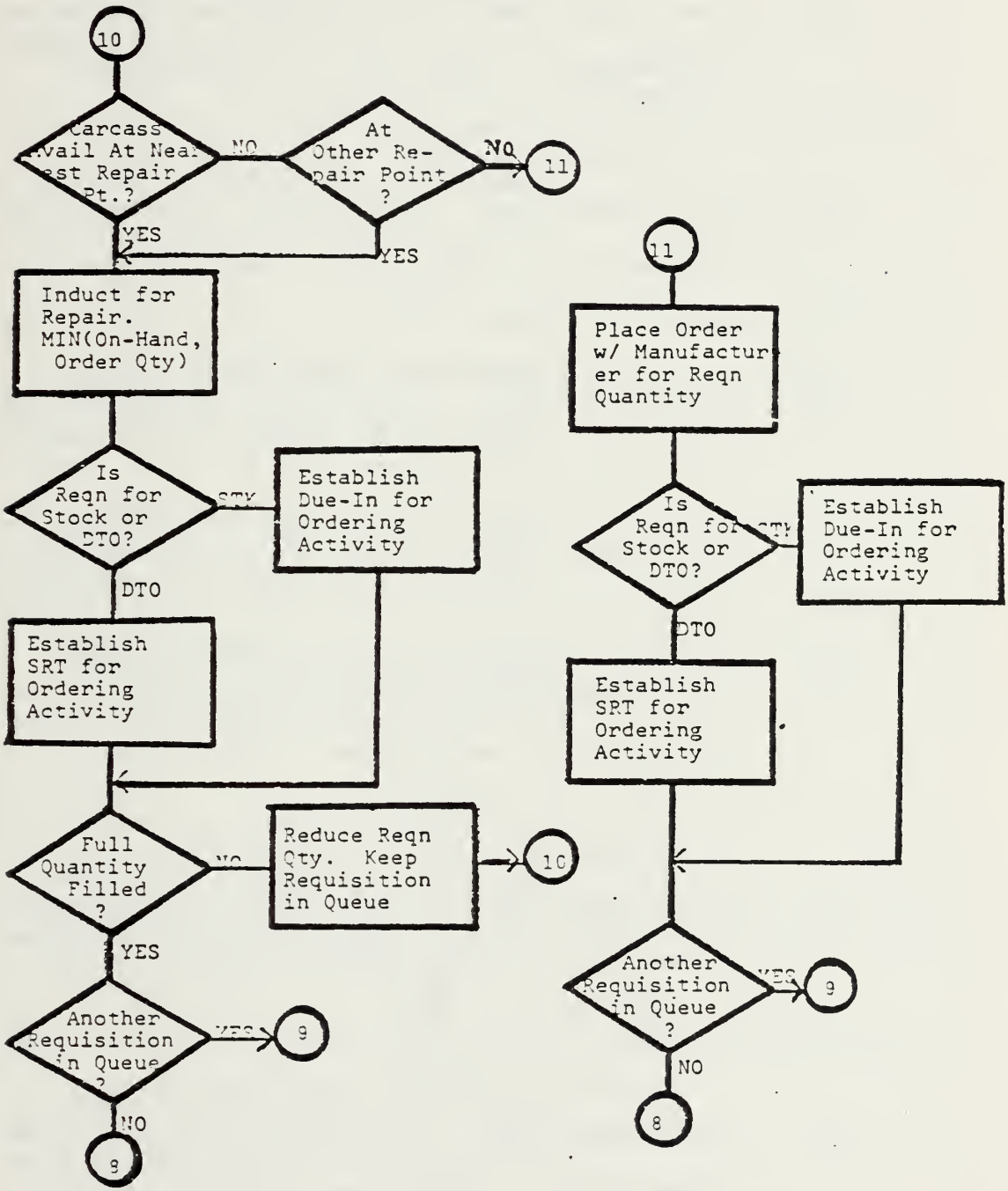
Flowchart: Depot and Supply Center Issue Process



Flowchart: ICP Redistribution and Reorder Process



Flowchart: ICP Repair and Procurement Process



APPENDIX E

SAMPLE METEOR OUTPUT

MISSION: 2

(Event Driven Output)

FAILURE OF EQUIPMENT TYPE 6 ON SHIP 16 AT TIME 74,
RESULTED IN THE FOLLOWING SUPPLY ACTIONS:

END USE REQUIREMENT FILLED BY SSN 16. SUPPLY RESPONSE TIME IS: 12.

ORDERS FOR STOCK WERE GENERATED AS FOLLOWS:

REQUISITIONOR(SSN)	DUE-IN AT TIME	ISSUED FROM(SSN)
16	710	34

FAILURE OF EQUIPMENT TYPE 7 ON SHIP 1 AT TIME 107,
RESULTED IN THE FOLLOWING SUPPLY ACTIONS:

END USE REQUIREMENT FILLED BY SSN 35. SUPPLY RESPONSE TIME IS: 624.

ORDERS FOR STOCK WERE GENERATED AS FOLLOWS:

REQUISITIONOR(SSN)	DUE-IN AT TIME	ISSUED FROM(SSN)
35	456	38

FAILURE OF EQUIPMENT TYPE 4 ON SHIP 16 AT TIME 141,
RESULTED IN THE FOLLOWING SUPPLY ACTIONS:

END USE REQUIREMENT FILLED BY SSN 34. SUPPLY RESPONSE TIME IS: 624.

NO ORDERS FOR STOCK RESULTED FROM THIS ISSUE.

FAILURE OF EQUIPMENT TYPE 7 ON SHIP 16 AT TIME 311,
RESULTED IN THE FOLLOWING SUPPLY ACTIONS:

END USE REQUIREMENT FILLED BY SSN 35. SUPPLY RESPONSE TIME IS: 523.

NO ORDERS FOR STOCK RESULTED FROM THIS ISSUE.

FAILURE OF EQUIPMENT TYPE 2 ON SHIP 16 AT TIME 314,
RESULTED IN THE FOLLOWING SUPPLY ACTIONS:

END USE REQUIREMENT FILLED BY SSN 16. SUPPLY RESPONSE TIME IS: 12.

ORDERS FOR STOCK WERE GENERATED AS FOLLOWS:

REQUISITIONOR(SSN)	DUE-IN AT TIME	ISSUED FROM(SSN)
16	476	32
32	676	34

FAILURE OF EQUIPMENT TYPE 1 ON SHIP 1 AT TIME 370,
RESULTED IN THE FOLLOWING SUPPLY ACTIONS:

END USE REQUIREMENT FILLED BY SSN 1. SUPPLY RESPONSE TIME IS: 12.

ORDERS FOR STOCK WERE GENERATED AS FOLLOWS:

REQUISITIONOR(SSN)	DUE-IN AT TIME	ISSUED FROM(SSN)
1	522	31
31	722	32
35	5386	38

FAILURE OF EQUIPMENT TYPE 6 ON SHIP 1 AT TIME 397,
RESULTED IN THE FOLLOWING SUPPLY ACTIONS:

END USE REQUIREMENT FILLED BY SSN 1. SUPPLY RESPONSE TIME IS: 12.

ORDERS FOR STOCK WERE GENERATED AS FOLLOWS:

REQUISITIONOR(SSN)	DUE-IN AT TIME	ISSUED FROM(SSN)
1	622	33

Sample Summary Output

DATA SUMMARY: MULTI-ECHELON SUPPLY SYSTEM

10 SIMULATED MISSIONS HAVE BEEN RUN. THE FOLLOWING SUMMARY STATISTICS ARE BASED ON AVERAGE NUMBERS PER MISSION.

I. PROCUREMENT COSTS

ECHELON SUMMARY

SHIPPED FROM MFR TO:	SHIPS	MLSF	DEPOT	SUPPLY CENTERS
NR. PROCUREMENTS	4.3	1.6	1.2	6.9
NR. ITEMS PROCURED	4.3	1.6	1.6	6.9

EQUIPMENT SUMMARY

EQUIPMENT NO.	1	2	3	4	5	6	7	8	9	0	0
NR. PROCUREMENTS	3.4	3.7	0.4	0.0	1.2	1.4	3.4	0.0	0.5	0.0	0.0
NR. ITEMS PROCURED	3.4	3.7	0.4	0.0	1.2	1.8	3.4	0.0	0.5	0.0	0.0

II. REPAIR COSTS

ECHELON SUMMARY

SHIPPED FR REPAIR FACILITY TO:	SHIPS	MLSF	DEPOT	SUPPLY CENTERS
NR. INDUCTIONS	0.7	0.0	0.1	0.0
NR. ITEMS INDUCTED	0.7	0.0	0.1	0.0

EQUIPMENT SUMMARY

EQUIPMENT NR.	1	2	3	4	5	6	7	8	9	0	0
NR. INDUCTIONS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.0
NR. ITEMS INDUCTED	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.0

NR. ITEMS RETURNED BY SHIPS TO REPAIR FACILITIES: 2.4

NR. REPAIRABLE CARCASSES LOST DUE TO ATTRITION: 0.1

III. TRANSPORTATION COSTS (NR. SHIPMENTS)

DESTINATION ACTIVITY

(DESINATIONS 1-6 REFER TO SHIP LOCATIONS)

		1	2	3	4	5	6	7	8	9	0	0
	MLSF-W (7)	0.0	0.0	3.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S	-E (8)	0.0	0.0	0.0	0.0	0.0	3.0	0.0	0.0	0.0	0.0	0.0
H	DEPOT (9)	0.0	0.0	1.9	0.0	0.0	0.0	0.7	0.0	0.0	0.0	0.0
I	CENTER-E (10)	0.0	0.0	0.9	0.0	0.0	1.7	0.0	2.1	0.0	0.0	0.0
P	-W (11)	0.0	0.0	1.5	0.0	0.0	1.7	1.8	0.2	0.0	0.0	0.0
P	REPAIR-E (12)	0.0	0.0	0.2	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0
E	-W (13)	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.1
R	MFR (14)	0.0	0.0	2.0	0.0	0.0	1.2	0.9	0.7	1.2	3.8	3.7

TOTAL NR. OF ISSUES FROM SHIP STOCK: 11.9

Sample Summary Output

IV. INVENTORY COSTS

INITIAL INVENTORY INVESTMENT

ECHELON: EQUIPMENT	SHIPS	MLSF	DEPOT	CENTERS
1	1000.00	1000.00	0.0	1000.00
2	200.00	100.00	0.0	100.00
3	700.00	0.0	0.0	700.00
4	0.0	0.0	2000.00	2000.00
5	1500.00	1500.00	750.00	2250.00
6	2500.00	0.0	2500.00	2500.00
7	0.0	0.0	0.0	599.00
8	4000.00	0.0	2000.00	4000.00
9	19998.00	0.0	0.0	9599.00
TOTALS:	29898.00	2600.00	7250.00	23548.00

TOTAL INVESTMENT: 63296.00

AVERAGE ON-HAND INVENTORY DOLLAR VALUE

ECHELON: EQUIPMENT	SHIPS	MLSF	DEPOT	CENTERS
1	467.73	443.05	0.0	366.89
2	113.16	39.33	0.0	23.25
3	576.29	0.0	0.0	575.60
4	0.0	0.0	1889.76	1541.97
5	697.47	697.47	269.33	1684.30
6	828.11	0.0	707.82	1558.52
7	0.0	0.0	0.0	47.85
8	3573.15	0.0	1842.38	3557.18
9	9851.71	0.0	0.0	3829.34
TOTALS:	16107.61	1179.85	4700.29	13184.89

TOTAL INVESTMENT: 35172.64

V. DEMAND HISTORY (TOTAL/NIS/NC)

ECHELON: EQUIPMENT	SHIPS	MLSF	DEPOT	CENTERS	TOTAL
1	2.4/0.8/0.0	3.4/1.3/0.0	1.6/0.0/1.6	1.8/1.0/0.0	10.2/3.1/1.6
2	4.0/0.3/0.0	4.0/1.2/0.0	2.1/0.0/2.1	1.9/0.5/0.0	12.0/2.4/2.1
3	0.6/0.1/0.0	0.6/0.0/0.6	0.2/0.0/0.2	0.4/0.1/0.0	1.8/0.2/0.8
4	0.2/0.0/0.2	0.2/0.0/0.2	0.0/0.0/0.0	0.2/0.0/0.0	0.6/0.0/0.4
5	1.6/0.2/0.0	1.6/0.1/0.0	1.1/0.4/0.0	0.5/0.0/0.0	4.8/0.7/0.0
6	3.3/1.2/0.0	3.0/0.0/3.0	1.8/0.0/0.0	1.2/0.4/0.0	9.3/1.6/3.0
7	3.4/0.0/3.4	3.4/0.0/3.4	2.6/0.0/2.6	0.8/0.0/0.8	10.2/0.0/***
8	0.4/0.1/0.0	0.4/0.0/0.4	0.1/0.0/0.0	0.3/0.1/0.0	1.2/0.2/0.4
9	1.9/0.6/0.0	1.9/0.0/1.9	0.9/0.0/0.9	1.0/0.0/1.0	5.7/0.6/3.8
TOTAL	18.8/ 3.3/ 3.6	18.5/ 2.6/ 9.5	10.4/ 0.4/ 7.4	8.1/ 2.5/ 1.8	

GRAND TOTAL: 55.8/ 8.8/ 22.3

HARDWARE SYSTEM PERFORMANCE SUMMARY

2 END USE ACTIVITIES WERE SIMULATED IN A MISSION OF DURATION 1000.
10 SIMULATED MISSIONS WERE RUN

THE FOLLOWING STATISTICS REPRESENT AVERAGES PER MISSION, PER END USE ACTIVITY

1. SYSTEM RELIABILITY (PROB OF SUCCESSFUL MISSION)

= 0.0

2. SYSTEM AVAILABILITY (PROB SYSTEM OPERATIONAL AT AN ARBITRARY TIME)

= 0.4589

APPENDIX F
METEOR PROGRAM LISTING

The program listing which follows, includes portions of the TIGER simulation and the complete multi-echelon supply program listing. Only the TIGER main program, and those subprograms changed as a result of METEOR, are presented. The major changes to TIGER are as follows when the multi-echelon supply option is in effect:

a) Deletion of the TIGER logistics system and associated input paramenters in subroutines TTE and PACK respectively.

b) Call statement to subroutine MULTE in TIGER subroutine TTE.

c) Call statement to subroutine MSTAT (supply system statistical summary) in TIGER main program.

d) Additional read statements for supply system parameters in TIGER main program.

e) Computation of equipment related performance measures in TIGER main program and subroutine RUN.

```
C       MAIN PROGRAM                                                                    MULC0010
C                                                                                       MULC0020
        COMMON /ALPHA/DNT2,ENDPHA,ICRI,IFF,IFR,INUM,IOPT,JBB,KEQ,KKK,KZZ               MULC0030
       1,KK1,KS1,LL,LLLAST,NEQ,NPH,NTYPE,NUM,REDAD2,REDAD1(100),RELP,RED2              MULC0040
       2,RELPY,REPOL,STPHAS,TP,T1,XCUM,TT3,UP3,IFFEOP,T3,TIME,T3SUM                    MULC0050
        COMMON/BETA/NRO(6,300),IB(6,300,8),NLINE(6)                                    MULC0060
        COMMON/EXTRA/ KS(20),ISW(31)                                                   MULC0070
        COMMON /N/IECU(500),KEQU(500),ETIME(1000),XMTBF(200),XMTTR(200)                MULC0080
        COMMON/NPH/ NSS(6),IFLAG(6),TITLE(6,31),SSTIME(6,31,2),ISS(6,31)               MULC0090
        COMMON /SEQ/INOABT(100),INMI(100),IAUP1(100),TT2(100),UP2(100)                 MULC0100
       1,IAUP2(100)                                                                    MULC0110
        COMMON /TYP/EX(2,200),ISPARE(3,200),IUSED(3,200),IIUSED(3,200)                 MULC0120
        COMMON /MAX/MAXNEQ,MAXTYP,MAXIB,MAXSTD                                         MULC0130
        COMMON /GAMMAA/XMTBA,VAR,RELGA(100),TIMA(100),XXT(200),ITT,ISEED               MULC0140
        COMMON /TABCRT/ XTABT(1000),RDT                                                MULC0150
        COMMON /TIGAP/ UP4,XNUM,BAPRIN,AVA,XPCAP,RUNID(19),TYCOON(500)                 MULC0160
       +,COUNTB(500),XTCUM                                                             MULC0170
        COMMON /DONE/DONE(3)                                                           MULC0180
C   **  BUNKER ADDS                                                                    MULC0190
        COMMON/NS/NUMSS(30),NRSHPS,ITOTEQ,NSSEQ(500),NRWCS                             MULC0200
        COMMON/STAT/XD(200,4),XT(4),XG,SUMD(200,4),SUMXD(200,4)                        MULC0210
        COMMON/ISTAT/NIST,NMFR(200,4,2),NNN(200,4,3),NRA,NRRT,                         MULC0220
       1NRF(200,4,2),NSHIP(14,14),IXD(200,4),IXT(4),IXG                                MULC0230
        COMMON/MP/CRAR,ALFA1,ALFA2,SSRT,ECCST(200),OSTSR(6),OSTM(11),                  MULC0240
       1OST(2,11,4)                                                                    MULC0250
        COMMON/ESTAT/UP4SS(30),DTSS1(30),DTSS2(30),XCUMSS(30),RELSS(30),               MULC0260
       1AVASS(30),ITEMSS(30)                                                           MULC0270
        COMMON/MULTI/MAXD,MULTC,MFLAG,IOPTM,IRC,IOPTP1                                 MULC0280
        COMMON/DT/SSADT                                                                MULC0290
C   **  BUNKER STOPS                                                                   MULC0300
        DATA  BLNK/4H    /                                                             MULC0310
C                                                                                       MULC0320
    5   MAXPUN=1000                                                                    MULC0330
        MAXNPH=6                                                                       MULC0340
        MAXSTD=50                                                                      MULC0350
        MAXNEQ=500                                                                     MULC0360
        MAXTYP=200                                                                     MULC0370
        MAXIB=300                                                                      MULC0380
        MAXSS=31                                                                       MULC0390
        MAXSEQ=100                                                                     MULC0400
C   **  BUNKER ADDS                                                                    MULC0410
        MAXD = 1000                                                                    MULC0420
        READ(5,10)ICPTM,IOPTP,IOPTP1,IRC,NRSHPS,ITOTEQ,NRWCS,SSADT                     MULC0430
        IF(IOPTM.EQ.0)GO TO 18                                                         MULC0440
        READ(5,11)(NUMSS(I),I=1,20)                                                    MULC0450
        IF(NRSHPS.GT.20) READ(5,11)(NUMSS(I),I=21,30)                                  MULC0460
   10 FORMAT(7I4,F7.0)                                                                 MULC0470
   11 FORMAT(20I4)                                                                     MULC0480
```

```
C   **  BUNKER STOPS                                                          MULC0490
   18 READ (5,19) JCC,(RUNID(I),I=1,19)                                      MUL00500
   19 FORMAT(I4,19A4)                                                        MUL00510
      WRITE (6,220) JCC                                                      MUL00520
      DO 1230 JC=1,JCC                                                       MUL00530
   20 WRITE (6,30) (RUNID(I),I=1,19)                                         MUL00540
   30 FORMAT(1H1,30X,19A4//)                                                 MUL00550
      WRITE (6,40)                                                           MUL00560
      WRITE (6,50)                                                           MUL00570
      WRITE (6,55)                                                           MUL00580
      WRITE (6,56)                                                           MUL00590
   40 FORMAT(1X,50H ++++++++++++++++++++    TIGER  ++++++++++++++++ )         MUL00600
   50 FORMAT(/1X,50H++ NAVSEC 6112 LUETJEN+MANDEL+VAIL+ALLEY+BROWN ++ )      MUL00610
   55 FORMAT(/1X,50H++NPS IBM/360 VERSION LT. J. LEATHER THESIS 9/80++)       MUL00620
   56 FORMAT(/1X,48H++AS AMENDED BY LCDR. T. A. BUNKER THESIS 3/83++)         MUL00630
      BAPRIN=0.0                                                             MUL00640
C   **  BUNKER ADDS                                                          MUL00650
      MULTC = 0                                                              MUL00660
C   **  BUNKER STOPS                                                         MUL00670
      DO 70 I=1,MAXNEC                                                       MUL00680
   60 COUNTB(I)=0.0                                                          MUL00690
      TYCOON(I)=0.0                                                          MUL00700
      KEQU(I)=0                                                              MUL00710
   70 ETIME(I)=100000.                                                       MUL00720
      NUM=0                                                                  MUL00730
      IFF=0                                                                  MUL00740
      IFR=0                                                                  MUL00750
      UP4=0.0                                                                MUL00760
C **  BUNKER ADDS                                                           MUL00770
      DO 71 I=1,30                                                           MUL00780
   71 UP4SS(I)=0.0                                                           MUL00790
C **  BUNKER STOPS                                                          MUL00800
      T3=0.0                                                                 MUL00810
      T3SUM=0.0                                                              MUL00820
      SUMX=0.0                                                               MUL00830
      SUMX2=0.0                                                              MUL00840
      DO 80 I=1,100                                                          MUL00850
   80 TIMA(I)=0.                                                             MUL00860
      DO 90 I=1,3                                                            MUL00870
      DO 90 J=1,MAXTYP                                                       MUL00880
   90 IIUSED(I,J)=0                                                          MUL00890
      DO 100 I=1,MAXSEC                                                      MUL00900
      TT2(I)=0.0                                                             MUL00910
      UP2(I)=0.0                                                             MUL00920
      IAUP1(I)=0                                                             MUL00930
      IAUP2(I)=0                                                             MUL00940
      READ1(I)=0.0                                                           MUL00950
      INMI(I)=0                                                              MUL00960
```

```
  100 INOABT(I)=0                                                        MUL00970
      IAUP=0                                                             MUL00980
      XTCUM=0                                                            MUL00990
C   **  BUNKER ADDS                                                      MUL01000
      DO 101 I=1,30                                                      MUL01010
  101 XCUMSS(I)=0.0                                                      MUL01020
C   **  BUNKER STOPS                                                     MUL01030
      IF (JC-1) 110,110,140                                              MUL01040
  110 READ (5,120) NMAX,NOPT,PL,XK,ISEED,NPH                             MUL01050
  120 FORMAT (2I4,2F4.0,2I4)                                             MUL01060
  130 FORMAT (1X2I6,2XF4.2,2XF5.2,2XI6,2XI4)                             MUL01070
  140 CONTINUE                                                           MUL01080
  160 WRITE (6,170) ISEED                                                MUL01090
  170 FORMAT (//1X15HRANDOM SEED IS ,I4)                                 MUL01100
      IF (NMAX-MAXRUN) 190,190,180                                       MUL01110
  180 NMAX=1000                                                          MUL01120
      NOPT=1000                                                          MUL01130
  190 DO 200 I=1,NMAX                                                    MUL01140
  200 XTABT(I)=100000.                                                   MUL01150
      WRITE (6,130) NMAX,NOPT,PL,XK,ISEED,NPH                            MUL01160
      IF (MAXNPH-NPH) 1260,210,210                                       MUL01170
  210 INUM=10                                                            MUL01180
  220 FORMAT (/1X,5HJCC= ,4I10)                                          MUL01190
  230 DO 250 I=1,191,10                                                  MUL01200
      READ (5,240) XXT(I),(XXT(I+J),J=1,9)                               MUL01210
      IF (XXT(I)) 260,260,250                                            MUL01220
  240 FORMAT (5(F2.0,F8.0))                                              MUL01230
  250 CONTINUE                                                           MUL01240
  260 WRITE (6,270)                                                      MUL01250
  270 FORMAT (1H1,10X40HPHASE SEQUENCE  TYPE  DURATION  CUM TIME)        MUL01260
      IK=1                                                               MUL01270
      IK2=2*IK                                                           MUL01280
      IK3=IK2-1                                                          MUL01290
      IXXT=XXT(IK3)                                                      MUL01300
      TIMA(1)=XXT(2)                                                     MUL01310
C   **  BUNKER ADDS                                                      MUL01320
      TPM = TIMA(1)                                                      MUL01330
C   **  BUNKER STOPS                                                     MUL01340
      WRITE (6,280) IK,IXXT,XXT(IK2),TIMA(IK)                            MUL01350
  280 FORMAT (19XI4,2XI4,2XF8.2,2XF8.2)                                  MUL01360
      DO 300 IK=2,100                                                    MUL01370
      IK2=2*IK                                                           MUL01380
      IK3=IK2-1                                                          MUL01390
      IF (XXT(IK2)) 290,310,290                                          MUL01400
  290 TIMA(IK)=TIMA(IK-1)+XXT(IK2)                                       MUL01410
      IXXT=XXT(IK3)                                                      MUL01420
      WRITE (6,280) IK,IXXT,XXT(IK2),TIMA(IK)                            MUL01430
C   **  BUNKER ADDS                                                      MUL01440
```

```
      TPM = TIMA(IK)                                                    MLLC1450
C  **  BUNKER STOPS                                                    MULC1460
  300 CONTINUE                                                         MLL01470
  310 CONTINUE                                                         MLL01480
      IF (JC-1) 320,320,330                                            MLL01490
  320 CALL PACK                                                        MUL01500
C                                                                      MUL01510
  330 CONTINUE                                                         MUL01520
      JBB=1                                                            MUL01530
      RELPY=1.0                                                        MUL01540
      RELP=1.                                                          MUL01550
      UP3=0.0                                                          MLL01560
      TT3=0.0                                                          MUL01570
      REDAD2=0.0                                                       MUL01580
      DO 340 I=1,MAXSS                                                 MUL01590
  340 ISW(I)=1                                                         MLL01600
      ICRI=0                                                           MLL01610
      DNT2=0.0                                                         MUL01620
C  **  BUNKER ADDS                                                    MLL01630
      DO 345 I=1,30                                                    MUL01640
      DTSS2(I)=0.0                                                     MUL01650
  345 ITEMSS(I)=0                                                      MUL01660
C  **  BUNKER STOPS                                                   MUL01670
  350 STPHAS=0                                                         MUL01680
      T1=0.0                                                           MUL01690
C                                                                      MUL01700
C     RDT IS RUNNING DOWNTIME                                          MUL01710
C                                                                      MUL01720
      RDT=0.0                                                          MUL01730
      IF (KS(8)) 380,380,360                                           MUL01740
  360 KAB=NUM+1                                                        MUL01750
      WRITE (6,370) KAB                                                MUL01760
  370 FORMAT(1X,16HSTART OF MISSION,I5,20H**********)                  MUL01770
  380 KKK=0                                                            MUL01780
  390 I=1                                                              MLL01790
C  **  BUNKER ADDS                                                    MUL01800
      MFLAG = 0                                                        MLL01810
C  **  BUNKER STOPS                                                   MUL01820
  400 LL=XXT(I)                                                        MUL01830
      IF (LL) 450,450,410                                              MUL01840
  410 ENDPHA=STPHAS+XXT(I+1)                                           MUL01850
      I=I+2                                                            MUL01860
      CALL RUN                                                         MLL01870
      IX=NUM+1                                                         MUL01880
      IF (XTABT(IX)) 420,420,440                                       MUL01890
  420 WRITE (6,430)                                                    MUL01900
  430 FORMAT (1X44HTHE ABORT TIME IS ZERO,CHECK THE INPUT DATA.)       MUL01910
      GO TO 1260                                                       MUL01920
```

```
  440 STPHAS=ENDPHA                                                      MULC1930
      N=NSS(LL)+1                                                        MULC1940
      GO TO 400                                                          MULC1950
C                                                                        MULC1960
  450 NUM=NUM+1                                                          MULC1970
      IF (IFFEOP) 460,460,480                                            MULC1980
  460 IFF=IFF+1                                                          MULC1990
      IF (T3) 470,480,470                                                MULC2000
  470 CONTINUE                                                           MULC2010
      T3SUM=T3SUM+T3                                                     MULC2020
      T3=0.0                                                             MULC2030
  480 XTCUM=XTCUM+XCUM                                                   MULC2040
C  **  BUNKER ADDS                                                       MULC2050
      DO 485 I=1,NRSHPS                                                  MULC2060
      IF(ITEMSS(I).EQ.0) XCUMSS(I)=XCUMSS(I)+1                           MULC2070
  485 UP4SS(I)=UP4SS(I)+ENDPHA-DTSS2(I)                                  MULC2080
C  **  BUNKER STOPS                                                      MULC2090
      UP4=UP4+ENDPHA-DNT2                                                MULC2100
      IF (XTABT(NUM)-100000.) 500,490,500                                MULC2110
  490 X=ENDPHA                                                           MULC2120
      GO TO 510                                                          MULC2130
  500 X=XTABT(NUM)                                                       MULC2140
  510 X2=X**2                                                            MULC2150
      SUMX=SUMX+X                                                        MULC2160
      SUMX2=SUMX2+X2                                                     MULC2170
      IF (ISW(N)) 530,530,520                                            MULC2180
  520 IAUP=IAUP+1                                                        MULC2190
  530 IF (NUM-INUM) 330,540,540                                          MULC2200
  540 INUM=INUM+10                                                       MULC2210
  550 WRITE(6,2017)                                                      MULC2220
      WRITE (6,560) NUM                                                  MULC2230
  560 FORMAT (/1X16HA GRAND TOTAL OF,I6,24H MISSIONS HAVE BEEN RUN.)     MULC2240
  570 XNUM=NUM                                                           MULC2250
  580 XPCAP=XTCUM/XNUM                                                   MULC2260
  590 WRITE (6,600) XPCAP                                                MULC2270
  600 FORMAT (1X24HTHE RELIABILITY IS      ,F8.4)                        MULC2280
  610 XPLCL=XPCAP-XK*SQRT(XPCAP*(1.-XPCAP)/XNUM)                         MULC2290
      IF (XPLCL) 620,630,630                                             MULC2300
  620 XPLCL=0.0                                                          MULC2310
  630 WRITE (6,640) XPLCL                                                MULC2320
  640 FORMAT (1X24HTHE LOWER CONF LIMIT IS ,F8.4)                        MULC2330
      WRITE (6,650) PL                                                   MULC2340
  650 FORMAT (1X24HTHE SPEC REQUIREMENT IS ,F8.4)                        MULC2350
      WRITE (6,660) RED2                                                 MULC2360
  660 FORMAT (1X17HTHE READINESS IS ,7XF8.4)                             MULC2370
      AVA=UP4/TT3                                                        MULC2380
      WRITE (6,670) AVA                                                  MULC2390
  670 FORMAT (1X28HTHE AVERAGE AVAILABILITY IS ,F8.4)                    MULC2400
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      XIAUP=IAUP                                                        MLLC2410
      AVAINS=XIAUP/XNUM                                                 MULO2420
      WRITE (6,680) AVAINS                                              MULO2430
  680 FORMAT (1X28HTHE INSTANT AVAILABILITY IS ,F8.4)                   MULO2440
      XDWN=XNUM-XTCUM                                                   MULO2450
      IF (XDWN) 69C,69C,70C                                             MULO2460
  690 XMTBA=2.0*SUMX                                                    MULO2470
      XLCLA=0.434*SUMX                                                  MULO2480
      VAR=(0.5*SUMX)**2                                                 MULO2490
      GO TO 710                                                         MULO2500
  700 XMTBA=SUMX/XDWN                                                   MULO2510
      VAR=(SUMX2/XNUM)-(SUMX/XNUM)**2                                   MULO2520
      CORR=(SUMX*(1/XDWN-1/XNUM))**2                                    MULO2530
      VAR=VAR+CORR                                                      MULO2540
      XLCLA=XMTBA-(1.28*SQRT(VAR))                                      MULO2550
  710 WRITE (6,720) XMTBA                                               MULO2560
  720 FORMAT (/1X41HTHE MEAN TIME BETWEEN MISSION FAILURES IS,F20.1)    MLLO2570
      WRITE (6,730) XLCLA                                               MULO2580
  730 FORMAT (1X21HTHE LCL,90, MTBMF IS ,F20.1)                         MULO2590
      WRITE (6,740) VAR                                                 MULO2600
  740 FORMAT (1X27HTHE MTBMF VARIANCE IS      ,F20.1)                   MULO2610
      XIFF=IFF                                                          MULO2620
      XIFR=IFR                                                          MULO2630
      IF (IFF) 76C,750,760                                              MLLO2640
  750 XMUT=2.0*UP4                                                      MULO2650
      XMDT=C.0                                                          MULO2660
      GO TO 790                                                         MULO2670
  76C XMUT=UP4/XIFF                                                     MULO2680
      IF (IFR) 78C,770,780                                              MULO2690
  770 XMDT=(TT3-UP4-T3SUM)/XIFF                                         MLLO2700
      GO TO 790                                                         MULO2710
  78C XMDT=(TT3-UP4-T3SUM)/XIFR                                         MULO2720
  790 WRITE (6,810) XMUT                                                MULO2730
  800 WRITE (6,820) XMDT                                                MULO2740
  810 FORMAT (/1X18HTHE SYSTEM MUT IS ,F20.1)                           MULO2750
  820 FORMAT (1X18HTHE SYSTEM MDT IS ,F20.3)                            MULO2760
  830 IF (XPCAP-PL) 84C,840,920                                         MLLO2770
  840 IF (NOPT-NUM) 87C,87C,850                                         MLLO2780
  850 WRITE (6,860)                                                     MULO2790
  860 FORMAT (1X14HANOTHER SET OF,3H 50,2CHMISSIONS WILL BE RUN,43H TO OMULO2800
     1BTAIN REQUIRED STATISTICAL CONFIDENCE.)                           MULO2810
      GO TO 330                                                         MULO2820
  870 WRITE (6,880)                                                     MULO2830
  880 FORMAT (1X52HSIMULATION COMPLETE-OPTIMUM NUMBER MISSIONS WERE RUN)MULO2840
      IF(PL.EQ.1.) GO TO 910                                            MULO2850
  890 WRITE (6,900)                                                     MULO2860
  900 FORMAT (1X33HWEAPON SYSTEM FAILS REQUIREMENTS.)                   MULO2870
  910 GO TO 1010                                                        MULO2880
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  920 IF (NMAX-NUM) 93C,93C,960                                                  MLL02890
  93C WRITE (6,940)                                                              MUL02900
  940 FORMAT (1X52HSIM COMPLETE-PREDEFINED MAX NUMBER MISSIONS WERE RUN)         MUL02910
  950 IF (XPLCL-PL) 89C,990,990                                                  MLL02920
  960 IF (XPLCL-PL) 85C,970,970                                                  MUL02930
  970 WRITE (6,980)                                                              MLL02940
  980 FORMAT (2X22HSIMULATION COMPLETE - )                                       MUL02950
      IF(PL.EQ.1.) GO TO 1010                                                    MLL02960
  990 WRITE (6,10CC)                                                             MUL02970
 1000 FORMAT (1X33HWEAPON SYSTEM MEETS REQUIREMENTS.)                            MUL02980
 1010 CONTINUE                                                                   MUL02990
 1019 IF (JC-1) 1020,1020,1230                                                   MUL03000
 1020 READ (5,1030) SPRS,APPL,GMMA,DMNO                                          MUL03010
 1030 FORMAT (4A4)                                                               MUL03020
C   **  BUNKER ADDS                                                             MUL03030
 1040 IF(IOPTM .EQ. 1) GO TO 1190                                                MUL03040
C1040 IF (SPRS.EQ.BLNK) GO TO 1190                                               MUL03050
      IF (SPRS.EQ.BLNK) GO TO 1190                                               MUL03060
C   **  BUNKER STOPS                                                            MUL03070
 1050 IDIFF=0                                                                    MUL03080
      TAFM=0.0                                                                   MUL03090
      TACMMH=0.0                                                                 MUL03100
      WRITE (6,106C)                                                             MUL03110
 1060 FORMAT (1H1,4X53HEQUIP FAILURES AND CORRECTIVE MAINTENANCE(CM) SUMMLL03120
     1MARY/8X71HEQUIP. NO.  TYPE NO.  TOTAL EQUIP.  AVG. NO. FAILURES  AMLL03130
     2VG. CM MANHCURS/32X8HFAILURES,7X11HPER MISSION,5X11HPER MISSION/)  MUL03140
      DO 1090 I=1,NEQ                                                            MUL03150
      IF(XMTTR(IEQU(I)).EQ.9999.) GO TO 1090                                     MLL03160
      IF (KEQU(I)) 1090,1090,1070                                                MUL03170
 1070 AFM=KEQU(I)/XNUM                                                           MUL03180
      IEQ=IABS(IEQU(I))                                                          MUL03190
      ACMMH=AFM*ABS(XMTTR(IEQ))                                                  MLL03200
      WRITE(6,1080) I,IEQ,KEQU(I),AFM,ACMMH                                      MLL03210
 1080 FORMAT (10XI4,6XI4,6XI10,6XF10.3,6XF10.3)                                  MUL03220
      IDIFF=IDIFF+KEQU(I)                                                        MUL03230
      TAFM=TAFM+AFM                                                              MLL03240
      TACMMH=TACMMH+ACMMH                                                        MLL03250
 1090 CONTINUE                                                                   MUL03260
      WRITE (6,11CC) IDIFF,TAFM,TACMMH                                           MUL03270
 1100 FORMAT (31X10H----------,6X10H----------,6X10H----------/31XI10,6XMUL03280
     1F10.3,6XF10.3)                                                             MLL03290
 1110 CONTINUE                                                                   MUL03300
      WRITE (6,1120)                                                             MUL03310
 1120 FORMAT (1H1,3X41HAVERAGE NUMBER OF SPARES USED PER MISSION)                MLL03320
      WRITE (6,1130)                                                             MLL03330
 1130 FORMAT (/4X6HSPARES,7X4HSHIP,18X6HTENDER,16X4HBASE)                        MUL03340
      WRITE (6,1140)                                                             MUL03350
 1140 FORMAT (8X4HTYPE,4X3(5HSTOCK,3X4HUSED,10X))                                MUL03360
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      DO 1170 J=1,NTYPE                                                    MULC3370
      ALDONE=0.0                                                           MULC3380
      DO 1150 I=1,3                                                        MULC3390
      DONE(I)=IIUSED(I,J)/XNUM                                             MULC3400
      ALDONE=ALDONE+DONE(I)                                                MULC3410
 1150 CONTINUE                                                             MULC3420
      IF(ALDONE) 1155,1170,1155                                            MULC3430
 1155 WRITE(6,1160)J,(ISPARE(I,J),DONE(I),I=1,3)                           MULC3440
 1160 FORMAT (8X14,4X3(I5,F7.2,10X))                                       MULC3450
 1170 CONTINUE                                                             MULC3460
 1180 CONTINUE                                                             MULC3470
 1190 IF (APPL.EQ.BLNK) GO TO 1210                                         MULC3480
 1200 BAPRIN=-1.0                                                          MULC3490
      CALL APPLE                                                           MULC3500
 1210 CONTINUE                                                             MULC3510
 1220 CONTINUE                                                             MULC3520
 1230 CONTINUE                                                             MULC3530
C   **  BUNKER ADDS                                                       MULC3540
      TOTREL=0.0                                                           MULC3550
      TOTAVA=0.0                                                           MULC3560
      DO 1241 I=1,30                                                       MULC3570
      AVASS(I)=0.                                                          MULC3580
 1241 RELSS(I)=0.                                                          MULC3590
      XNRSHP=FLOAT(NRSHPS)                                                 MULC3600
      DO 1242 I=1,NRSHPS                                                   MULC3610
      RELSS(I)=XCUMSS(I)/XNUM                                              MULC3620
      TOTREL=TOTREL + RELSS(I)                                             MULC3630
      AVASS(I)=UP4SS(I)/TT3                                                MULC3640
 1242 TOTAVA=TOTAVA+AVASS(I)                                               MULC3650
      ASREL=TOTREL/XNRSHP                                                  MULC3660
      ASAVA=TOTAVA/XNRSHP                                                  MULC3670
      IF (IOPTM .EQ. 0) GO TO 1260                                         MULC3680
      CALL MSTAT(NUM,NTYPE,TPM,IOPTP)                                      MULC3690
      WRITE(6,2017)                                                        MULC3700
      WRITE(6,1011)                                                        MULC3710
      WRITE(6,1012)NRSHPS,ENDPHA                                           MULC3720
      WRITE(6,1013)NUM                                                     MULC3730
      WRITE(6,1014)                                                        MULC3740
      WRITE(6,1015)                                                        MULC3750
      WRITE(6,1016)ASREL                                                   MULC3760
      WRITE(6,1017)                                                        MULC3770
      WRITE(6,1016)ASAVA                                                   MULC3780
      WRITE(6,2017)                                                        MULC3790
 2017 FORMAT('0',80('-')/)                                                 MULC3800
 1011 FORMAT('0',15X,'HARDWARE SYSTEM PERFORMANCE SUMMARY')                MULC3810
 1012 FORMAT('0',5X,I2,' END USE ACTIVITES WERE SIMULATED IN A MISSION OF MULC3820
     XF DURATION',F7.0)                                                    MULC3830
 1013 FORMAT(6X,I4,' SIMULATED MISSIONS WERE RUN')                         MULC3840
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 1014 FORMAT('0',5X,'THE FOLLOWING STATISTICS REPRESENT AVERAGES PER MIS MUL03850
     XSION, PER END USE ACTIVITY')                                      MUL03860
 1015 FORMAT('0',5X,'1.  SYSTEM RELIABILITY (PROB OF SUCCESSFUL MISSION) MUL03870
     X')                                                                MUL03880
 1016 FORMAT('0',15X,'= ',F6.4)                                         MUL03890
 1017 FORMAT('0',5X,'2.  SYSTEM AVAILABILITY (PROB SYSTEM OPERATIONAL AT MUL03900
     X AN ARBITRARY TIME)')                                             MUL03910
C  **  BUNKER STOPS                                                    MUL03920
 1260 STOP                                                              MUL03930
      END                                                               MUL03940
C                                                                       MUL03950
C                                                                       MUL03960
CCC                                                                     MUL03970
C                                                                       MUL03980
      SUBROUTINE RUN                                                    MUL03990
      COMMON /MAX/MAXNEQ,MAXTYP,MAXIB,MAXSTD                            MUL04000
      COMMON /ALPHA/DNT2,ENDPHA,ICRI,IFF,IFR,INUM,IOPT,JBB,KEQ,KKK,KZZ  MUL04010
     1,KK1,KS1,LL,LLLAST,NEQ,NPH,NTYPE,NUM,REDAD2,REDAD1(100),RELP,RED2 MUL04020
     2,RELPY,REPOL,STPHAS,TP,T1,XCUM,TT3,UP3,IFFEOP,T3,TIME,T3SUM       MUL04030
      COMMON/BETA/NRO(6,300),IB(6,300,8),NLINE(6)                       MUL04040
      COMMON/EXTRA/ KS(20),ISW(31)                                      MUL04050
      COMMON /N/IEQU(500),KEQU(500),ETIME(1000),XMTBF(200),XMTTR(200)   MUL04060
      COMMON/NPH/ NSS(6),IFLAG(6),TITLE(6,31),SSTIME(6,31,2),ISS(6,31)  MUL04070
      COMMON /SEQ/INOABT(100),INMI(100),IAUP1(100),TT2(100),UP2(100)    MUL04080
     1,IAUP2(100)                                                       MUL04090
      COMMON /TYP/EX(2,200),ISPARE(3,200),IUSED(3,200),IIUSED(3,200)    MUL04100
      COMMON /GAMMAA/XMTBA,VAR,RELGA(100),TIMA(100),XXT(200),ITT,ISEED  MUL04110
      COMMON /TABCRT/ XTABT(1000),RDT                                   MUL04120
      COMMON /DELTA/KKK2                                                MUL04130
      COMMON /XXX/XXX                                                   MUL04140
      COMMON/VCC/VCC(50,6),IUI(200),VMTTR(200,6),TAD2                   MUL04150
      COMMON/STAN/ISTB(60,10,6)                                         MUL04160
      COMMON/RUNAP/ITEMP2,DELT,ISSA(31),ISSC                            MUL04170
      COMMON/MULTI/MAXD,MULTC,MFLAG,IOPTM,IRC,IOPTP1                    MUL04180
      COMMON/NS/NUMSS(30),NRSHPS,ITOTEQ,NSSEQ(500),NRWCS                MUL04190
      COMMON/ESTAT/UP4SS(30),DTSS1(30),DTSS2(30),XCUMSS(30),RELSS(30),  MUL04200
     1AVASS(30),ITEMSS(30)                                              MUL04210
      COMMON/DT/SSADT                                                   MUL04220
C                                                                       MUL04230
      TDEOP=0.0                                                         MUL04240
      TP=STPHAS                                                         MUL04250
      KAA=NUM+1                                                         MUL04260
      XKAA=KAA                                                          MUL04270
      NX=NSS(LL)                                                        MUL04280
      N=NX+1                                                            MUL04290
      ITEMP=0                                                           MUL04300
      ITEMP2=0                                                          MUL04310
      IF (KKK) 40,10,40                                                 MUL04320
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```
   10 DO 20 I=1,3                                                    MULC4330
      DO 20 J=1,NTYPE                                                MULC4340
      IUSED(I,J)=0                                                   MULC4350
   20 CONTINUE                                                       MULC4360
      DO 30 I=1,NEQ                                                  MULC4370
   30 ETIME(I)=100000.                                               MULC4380
   40 CONTINUE                                                       MULC4390
C                                                                    MULC4400
   50 DO 120 ILB=1,NEQ                                               MULC4410
      KEQ=ILB                                                        MULC4420
      IF(ETIME(KEQ)+100001.001)55,120,55                             MULC4430
   55 IF(ETIME(KEQ)+99999.)60,60,120                                 MULC4440
   60 IF (IFLAG(LL)) 120,70,120                                      MULC4450
C                                                                    MULC4460
   70 ETIME(KEQ)=STPHAS                                              MULC4470
      IABC=IABS(IEQU(KEQ))                                           MULC4480
      IF (XMTTR(IABC)) 80,80,100                                     MULC4490
   80 XXX=VMTTR(IABC,LL)                                             MULC4500
      IF (XXX-9999.) 120,90,120                                      MULC4510
   90 ETIME(KEQ)=-99999.                                             MULC4520
      GO TO 120                                                      MULC4530
  100 XXX=XMTTR(IABC)                                                MULC4540
  110 CALL TTE                                                       MULC4550
  120 CONTINUE                                                       MULC4560
C                                                                    MULC4570
      DO 140 ILB=1,NEQ                                               MULC4580
      KEQ=ILB                                                        MULC4590
      IEQU(KEQ)=IABS(IEQU(KEQ))                                      MULC4600
      IF (ETIME(KEQ)-100000.) 130,140,130                            MULC4610
  130 IEQU(KEQ)=-IABS(IEQU(KEQ))                                     MULC4620
  140 CONTINUE                                                       MULC4630
  150 CONTINUE                                                       MULC4640
C                                                                    MULC4650
      KKK2=KKK                                                       MULC4660
      K=NLINE(LL)                                                    MULC4670
      DO 250 I=1,K                                                   MULC4680
      DO 250 J=2,8                                                   MULC4690
      KEQ=IABS(IB(LL,I,J))                                           MULC4700
      IF (KEQ-MAXNEQ) 151,151,250                                    MULC4710
  151 IF(KEQ)250,250,155                                             MULC4720
  155 IF(ETIME(KEQ)+100001.001)160,250,160                           MULC4730
  160 IEQU(KEQ)=IABS(IEQU(KEQ))                                      MULC4740
      IABC=IFQU(KEQ)                                                 MULC4750
      IF (XMTTR(IABC)) 170,170,180                                   MULC4760
  170 IF (VMTTR(IABC,LL)-9999.) 180,190,180                          MULC4770
  180 CONTINUE                                                       MULC4780
      IF (IFLAG(LL)-1) 210,190,210                                   MULC4790
  190 IF (ETIME(KEQ)) 200,210,210                                    MULC4800
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  200 ETIME(KEQ)=ETIME(KEQ)-(ENDPHA-STPHAS)                          MULC4810
  210 IF (ETIME(KEQ)-100000.) 220,240,220                            MULC4820
  220 IF (ABS(ETIME(KEQ))-STPHAS) 240,230,230                        MULC4830
  230 IF (STPHAS) 250,240,250                                        MULC4840
  240 ETIME(KEQ)=-STPHAS                                             MULC4850
      IABC=IABS(IEQU(KEQ))                                           MULC4860
      XXX=XMTBF(IABC)                                                MULC4870
      CALL TTE                                                       MULC4880
  250 CONTINUE                                                       MULC4890
      KKK2=1                                                         MULC4900
C                                                                    MULC4910
      DO 330 ILB=1,NEQ                                               MULC4920
      KEQ=ILB                                                        MULC4930
      IF(ETIME(KEQ)+10000.001)255,330,255                            MULC4940
  255 IF(IEQU(KEQ))260,260,330                                       MULC4950
  260 IEQU(KEQ)=IABS(IEQU(KEQ))                                      MULC4960
      IABC=IEQU(KEQ)                                                 MULC4970
      IF (XMTTR(IABC)) 270,270,280                                   MULC4980
  270 IF (VMTTR(IABC,LL)-9999.) 280,290,280                          MULC4990
  280 CONTINUE                                                       MULC5000
      IF (IFLAG(LL)-1) 310,290,310                                   MULC5010
  290 IF (ETIME(KEQ)) 300,320,320                                    MULC5020
  300 ETIME(KEQ)=ETIME(KEQ)-(ENDPHA-STPHAS)                          MULC5030
      GO TO 330                                                      MULC5040
C                                                                    MULC5050
  310 IF(ETIME(KEQ)) 331,320,320                                     MULC5060
  320 ETIME(KEQ)=100000.                                             MULC5070
      IEQU(KEQ)=IABS(IEQU(KEQ))                                      MULC5080
      GO TO 330                                                      MULC5090
  331 IEQU(KEQ)=-IABS(IEQU(KEQ))                                     MULC5100
  330 CONTINUE                                                       MULC5110
C                                                                    MULC5120
      CALL STATUS                                                    MULC5130
      CALL STNDBY                                                    MULC5140
C                                                                    MULC5150
      CALL STATUS                                                    MULC5160
      IF (ISW(N)) 350,350,340                                        MULC5170
  340 IAUP1(JBB)=IAUP1(JBB)+1                                        MULC5180
  350 XIAUPI=IAUP1(JBB)                                              MULC5190
      XAVI=XIAUPI/XKAA                                               MULC5200
C                                                                    MULC5210
      TIME=STPHAS                                                    MULC5220
      DNT1=0.0                                                       MULC5230
C   **  BUNKER ADDS                                                  MULC5240
      DO 351 I=1,30                                                  MULC5250
  351 DTSS1(I)=0.0                                                   MULC5260
C   **  BUNKER STOPS                                                 MULC5270
      DO 360 KSS=1,N                                                 MULC5280
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  360 SSTIME(LL,KSS,1)=0.0                                                  MULC5290
C                                                                           MULC5300
  370 TP=TIME                                                               MULC5310
      CALL STNDBY                                                           MULC5320
  380 IF (KS(6)) 390,440,390                                                MULC5330
  390 WRITE (6,430) TP                                                      MULC5340
      DO 410 J=1,NEQ                                                        MULC5350
      IF (ETIME(J)-100000.) 400,410,400                                     MULC5360
  400 IEQ=IABS(IECU(J))                                                     MULC5370
      WRITE(6,420) J,IEQ,ETIME(J)                                           MULC5380
  410 CONTINUE                                                              MULC5390
  420 FORMAT (1XI5,1XI5,5XF22.4)                                            MULC5400
  430 FORMAT (1XF12.4)                                                      MULC5410
  440 CALL EVENT                                                            MULC5420
      TIME=ABS(ETIME(KEQ))                                                  MULC5430
  446 IF (KS(5)) 450,470,450                                                MULC5440
  450 WRITE (6,460) KEQ,ETIME(KEQ),KAA                                      MULC5450
  460 FORMAT (10X5HEQUIP,I5,F12.4,5X7HMISSION,I10)                          MULC5460
  470 DELT=TIME-TP                                                          MULC5470
      CALL STATUS                                                           MULC5480
C                                                                           MULC5490
  480 DO 510 KSS=1,NX                                                       MULC5500
      IF (ISW(KSS)) 490,490,500                                             MULC5510
  490 SSTIME(LL,KSS,1)=SSTIME(LL,KSS,1)+DELT                                MULC5520
      GO TO 510                                                             MULC5530
  500 SSTIME(LL,KSS,1)=0.0                                                  MULC5540
  510 CONTINUE                                                              MULC5550
      IF (ISW(N)) 520,520,530                                               MULC5560
  520 SSTIME(LL,N,1)=SSTIME(LL,N,1)+DELT                                    MULC5570
      T3=T3+DELT                                                            MULC5580
      IF (TIME-ENDPHA) 522,522,521                                          MULC5590
  521 T3=T3+ENDPHA-TP-DELT                                                  MULC5600
  522 RDT=RDT+DELT                                                          MULC5610
      GO TO 550                                                             MULC5620
  530 T3=0.0                                                                MULC5630
      RDT=0.0                                                               MULC5640
      IF (SSTIME(LL,N,1)) 1140,550,540                                      MULC5650
  540 T1=SSTIME(LL,N,1)                                                     MULC5660
      SSTIME(LL,N,1)=0.0                                                    MULC5670
  550 CONTINUE                                                              MULC5680
C                                                                           MULC5690
      IF (SSTIME(LL,N,1)) 570,560,570                                       MULC5700
  560 IF (T1) 620,620,580                                                   MULC5710
  570 IF (T1) 620,610,620                                                   MULC5720
  580 IFF=IFF+1                                                             MULC5730
  590 IFR=IFR+1                                                             MULC5740
  600 T1=0.0                                                                MULC5750
      GO TO 620                                                             MULC5760
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  610 T1=SSTIME(LL,N,1)                                                  MULC5770
  620 CONTINUE                                                           MULC5780
C   **  BUNKER ADDS                                                      MULC5790
      DO 628 I=1,NRSHPS                                                  MULC5800
      DIFFT=SSTIME(LL,I,1)-SSADT                                         MULC5810
      IF(DIFFT)628,628,622                                               MULC5820
  622 IF(TIME-DIFFT-ENDPHA)624,628,628                                   MULC5830
  624 ITEMSS(I)=1                                                        MULC5840
  628 CONTINUE                                                           MULC5850
C   **  BUNKER STOPS                                                     MULC5860
C                                                                        MULC5870
      IF(ICRI) 640,640,660                                               MULC5880
C                                                                        MULC5890
  640 ISSC=1                                                             MULC5900
      ISSA(1)=N                                                          MULC5910
      IF(RDT-TAD2)645,645,930                                            MULC5920
  645 ICRI=0                                                             MULC5930
      IF(SSTIME(LL,N,1)-SSTIME(LL,N,2)) 650,650,960                      MULC5940
  650 ICRI=0                                                             MULC5950
      ISSC=0                                                             MULC5960
      DO 655 KSS=1,NX                                                    MULC5970
      IF(SSTIME(LL,KSS,1)-SSTIME(LL,KSS,2))655,655,652                   MULC5980
  652 ISSC=ISSC+1                                                        MULC5990
      ISSA(ISSC)=KSS                                                     MULC6000
  655 CONTINUE                                                           MULC6010
      IF(ISSC)660,660,962                                                MULC6020
  660 CONTINUE                                                           MULC6030
C                                                                        MULC6040
      IF (TIME-ENDPHA) 670,670,1140                                      MULC6050
  670 IF (ISW(N)) 680,680,730                                            MULC6060
  680 CALL APPLE                                                         MULC6070
  730 IF (ETIME(KEQ)) 810,810,740                                        MULC6080
  740 IABC=IABS(IEQU(KEQ))                                               MULC6090
      IF (IFLAG(LL)-1) 750,750,750                                       MULC6100
  750 CALL LRND(ISEED,RN,1,16807,0)                                      MULC6110
      IF (RN-REPOL) 770,770,800                                          MULC6120
  760 ETIME(KEQ)=-99999.                                                 MULC6130
      GO TO 830                                                          MULC6140
  770 IF (XMTTR(IABC)) 780,780,790                                       MULC6150
  780 XXX=VMTTR(IABC,LL)                                                 MULC6160
      IF (XXX-9999.) 820,760,820                                         MULC6170
  790 XXX=XMTTR(IABC)                                                    MULC6180
      GO TO 820                                                          MULC6190
  800 ETIME(KEQ)=-100001.001                                             MULC6200
      GO TO 830                                                          MULC6210
  810 IABC=IABS(IEQU(KEQ))                                               MULC6220
      XXX=XMTBF(IABC)                                                    MULC6230
  820 IF(IEQU(KEQ))811,821,821                                           MULC6240
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  811 IEQU(KEQ)=IABS(IEQU(KEQ))                                                  MULC6250
C                                                                                MULC6260
      ETIME(KEQ)=100000.                                                         MULC6270
      GO TO 830                                                                  MULC6280
  821 CALL TTE                                                                   MULC6290
C  **  BUNKER ADDS                                                             MULC6300
      INDIC=0                                                                    MULC6310
C  **  BUNKER STOPS                                                            MULC6320
  830 IF (ETIME(KEQ)) 840,831,870                                                MULC6330
C                                                                                MULC6340
C  **  BUNKER ADDS                                                             MULC6350
C NOTE: LABEL 830 CHANGED FROM 840,1150,870                                      MULC6360
  831 INDIC = -1                                                                 MULC6370
      GO TO 1140                                                                 MULC6380
C  **  BUNKER STOPS                                                            MULC6390
  840 KEQU(KEQ)=KEQU(KEQ)+1                                                      MULC6400
C  **  BUNKER ADDS                                                             MULC6410
      DO 842 I=1,NRSHPS                                                          MULC6420
      IF(ISW(I))841,841,842                                                      MULC6430
  841 DTSS1(I)=DTSS1(I)+DELT                                                     MULC6440
  842 CONTINUE                                                                   MULC6450
C  **  BUNKER STOPS                                                            MULC6460
  849 IF (ISW(N)) 850,850,370                                                    MULC6470
  850 DNT1=DNT1+DELT                                                             MULC6480
      IF (ICRI) 860,370,860                                                      MULC6490
  860 REDAD1(JBB)=REDAD1(JBB)+DELT                                               MULC6500
      GO TO 370                                                                  MULC6510
C                                                                                MULC6520
  870 CONTINUE                                                                   MULC6530
C  **  BUNKER ADDS                                                             MULC6540
      DO 873 I=1,NRSHPS                                                          MULC6550
      IF(ISW(I)) 871,871,873                                                     MULC6560
  871 DTSS1(I)=DTSS1(I) + DELT                                                   MULC6570
  873 CONTINUE                                                                   MULC6580
C  **  BUNKER STOPS                                                            MULC6590
  879 IF (ISW(N)) 880,880,370                                                    MULC6600
  880 DNT1=DNT1+DELT                                                             MULC6610
      IF (ICRI) 890,900,890                                                      MULC6620
  890 REDAD1(JBB)=REDAD1(JBB)+DELT                                               MULC6630
  900 TDOWN=TIME-SSTIME(LL,N,1)                                                  MULC6640
      TTEMP=SSTIME(LL,N,1)                                                       MULC6650
      IF (KS(13)) 370,370,910                                                    MULC6660
  910 WRITE (6,920) LL,TDOWN,TTEMP,KAA                                           MULC6670
  920 FORMAT (13H DURING PHASE,I6,20HSYSTEM WENT DOWN AT ,F14.4,13H DOWNMULC6680
     1TIME IS ,F14.4,3X7HMISSION,I6)                                             MULC6690
      GO TO 370                                                                  MULC6700
C                                                                                MULC6710
  930 ICRI=5                                                                     MULC6720
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      TABORT=TIME-(RDT-TAD2)                                                    MUL06730
      IF(TABORT-ENDPHA)940,645,645                                              MUL06740
  940 IF (XTABT(KAA)-100000.) 660,950,660                                       MUL06750
  950 ITEMP=1                                                                   MUL06760
      ITEMP2=1                                                                  MUL06770
C   **  BUNKER ADDS                                                           MUL06780
      IF(IOPTM.EQ.1) GO TO 955                                                  MUL06790
C   **  BUNKER STOPS                                                          MUL06800
      WRITE(6,1010)LL,JBB,KAA,TABORT,TITLE(LL,N)                                MUL06810
      WRITE(6,1011)TAD2                                                         MUL06820
  955 CONTINUE                                                                  MUL06830
      GO TO 1020                                                                MUL06840
  960 ICRI=4                                                                    MUL06850
      GO TO 964                                                                 MUL06860
  962 ICRI=2                                                                    MUL06870
  964 TABORT=TIME-(SSTIME(LL,ISSA(1),1)-SSTIME(LL,ISSA(1),2))                   MUL06880
  970 IF (TABORT-ENDPHA) 990,980,980                                            MUL06890
  980 IF(ICRI-2)650,985,650                                                     MUL06900
  985 ICRI=0                                                                    MUL06910
      GO TO 660                                                                 MUL06920
C                                                                               MUL06930
  990 IF (XTABT(KAA)-100000.) 660,1000,660                                      MUL06940
 1000 ITEMP=1                                                                   MUL06950
      ITEMP2=1                                                                  MUL06960
C   **  BUNKER ADDS                                                           MUL06970
      IF(IOPTM .EQ. 1)GO TO 1006                                                MUL06980
C   **  BUNKER STOPS                                                          MUL06990
      DO 1005 I=1,ISSC                                                          MUL07000
      WRITE(6,1009)LL,JBB,KAA,TABORT,TITLE(LL,ISSA(I))                          MUL07010
 1005 WRITE(6,1008)SSTIME(LL,ISSA(I),2)                                         MUL07020
 1006 CONTINUE                                                                  MUL07030
 1009 FORMAT(1X9HIN PHASE ,I2,1X3HSEQ,I3,4X7HMISSION,I6,4X15HABORTED AT        MUL07040
     1TIME,F10.4,10H  BECAUSE ,A4)                                              MUL07050
 1008 FORMAT(1X34HEXCEEDED PHASE ALLOWABLE DOWNTIME,2XF10.3,5H HRS.)            MUL07060
 1010 FORMAT (1X9HIN PHASE ,I2,1X3HSEQ,I3,4X7HMISSION,I6,4X15HABORTED AT       MUL07070
     1 TIME,F10.4,10H  BECAUSE ,A4)                                             MUL07080
 1011 FORMAT(1X36HEXCEEDED MISSION ALLOWABLE DOWNTIME,2XF10.3,5H HRS.)          MUL07090
 1020 XTABT(KAA)=TABORT                                                         MUL07100
      IF (TABORT) 1590,1590,1040                                                MUL07110
 1040 DO 1110 I=1,NEQ                                                           MUL07120
      IF (ETIME(I)) 1050,1110,1110                                              MUL07130
 1050 IF (IECU(I)) 1080,1110,1080                                               MUL07140
 1080 IF (KS(2)) 1090,1110,1090                                                 MUL07150
 1090 WRITE (6,1100) I,ETIME(I)                                                 MUL07160
 1100 FORMAT (17X9HEQUIPMENT,I5,24H DOWN IT WILL COME UP AT,F16.4)              MUL07170
 1110 CONTINUE                                                                  MUL07180
 1120 CALL APPLE                                                                MUL07190
      ITEMP2=0                                                                  MUL07200
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 1130 GO TO 660                                                                 MULC7210
C                                                                               MULC7220
 1140 CONTINUE                                                                  MULC7230
      IFFEOP=ISW(N)                                                             MULC7240
C   **  BUNKER ADDS                                                            MULC7250
      DO 1148 I=1,NRSHPS                                                        MULC7260
      IF(INCIC)1142,1141,1141                                                   MULC7270
 1141 IF(ISW(I))1142,1142,1148                                                  MULC7280
 1142 TDEOP=ENDPHA-TP                                                           MULC7290
      DTSS1(I)=DTSS1(I)+TDEOP                                                   MULC7300
 1148 CONTINUE                                                                  MULC7310
      IF(INCIC)115C,1149,1149                                                   MULC7320
C   **  BUNKER STOPS                                                           MULC7330
 1149 IF (ISW(N)) 1160,1160,1270                                                MULC7340
 1150 CONTINUE                                                                  MULC7350
 1160 TDEOP=ENDPHA-TP                                                           MULC7360
 1170 CONTINUE                                                                  MULC7370
      IF (KS(3)) 1210,1210,1180                                                 MULC7380
 1180 IF (TDEOP) 1190,1210,1190                                                 MULC7390
 1190 WRITE (6,1200) LL,TDEOP,KAA                                               MULC7400
 1200 FORMAT (1X27HSYSTEM DOWN AT END OF PHASE,I6,13H FOR DURATION,F10.4MULC7410
     1,6X7HMISSION,I6)                                                          MULC7420
 121C CONTINUE                                                                  MULC7430
      DNT1=DNT1+TDEOP                                                           MULC7440
      RDT=RDT+TDEOP-DELT                                                        MULC7450
      DELT=TDEOP                                                                MULC7460
      CALL APPLE                                                                MULC7470
 127C CONTINUE                                                                  MULC7480
C   **  BUNKER ADDS                                                            MULC7490
      DO 1288 I=1,NRSHPS                                                        MULC7500
 1288 DTSS2(I)=DTSS2(I)+DTSS1(I)                                                MULC7510
C   **  BUNKER STOPS                                                           MULC7520
      IF (ICRI) 1280,1290,1280                                                  MULC7530
 128C READ1(JBB)=READ1(JBB)+TDEOP                                              MULC7540
 1290 DNT2=DNT2+DNT1                                                            MULC7550
 1300 IF (DNT2) 1310,1330,1310                                                  MULC7560
 1310 IF(KS(6)) 1325,1330,1325                                                  MULC7570
 1325 WRITE(6,132C) LL,KAA,DNT2                                                 MULC7580
 1320 FORMAT (1X5HPHASE,I5,1X29HTOTAL SYS DOWNTIME IN MISSION,I5,1X3HWASMULC7590
     1,F12.4,4H HRS)                                                            MULC7600
 1330 CONTINUE                                                                  MULC7610
C                                                                               MULC7620
      IF (ICRI) 1350,1350,1340                                                  MULC7630
 1340 IF (ITEMP) 1360,1360,1350                                                 MULC7640
 1350 XCUM=1-ITEMP                                                              MULC7650
      INOABT(JBB)=INOABT(JBB)+1-ITEMP                                           MULC7660
      INMI(JBB)=INMI(JBB)+1                                                     MULC7670
 1360 CONTINUE                                                                  MULC7680
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      XNO=INCABT(JBB)                                                    MULC7690
      TNMI=INMI(JBB)                                                     MULC7700
      IF (TNMI) 1380,1380,1370                                           MULC7710
 1370 RELY=XNO/TNMI                                                      MULC7720
      GO TO 1390                                                         MULC7730
 1380 RELY=0.0                                                           MULC7740
 1390 RELPY=RELPY*RELY                                                   MULC7750
      TT1=ENDPHA-STPHAS                                                  MULC7760
      TT2(JBB)=TT2(JBB)+TT1                                              MULC7770
      UP1=TT1-DNT1                                                       MULC7780
      UP2(JBB)=UP2(JBB)+UP1                                              MULC7790
      IF (ISW(N)) 1410,1410,1400                                         MULC7800
 1400 IAUP2(JBB)=IAUP2(JBB)+1                                            MULC7810
 1410  XIAUPP=IAUP2(JBB)                                                 MULC7820
      XAV=XIAUPP/XKAA                                                    MULC7830
      IF (KAA-INUM) 1570,1420,1570                                       MULC7840
 1420 WRITE (6,1430) XAVI                                                MULC7850
 1430 FORMAT (/47X20HINSTANT AVAILABILITY,5X2X4H IS ,F6.4)               MULC7860
 1440 WRITE (6,1450) LL,JBB,RELY,LL,RELPY                                MULC7870
 1450 FORMAT (9X17HRELIABILITY PHASE,I3,1H,,I3,5H, IS ,F6.4,3X25HRELIABIMULC7880
     1LITY UP TO PHASE  ,I2,4H IS ,F6.4)                                 MULC7890
C                                                                        MULC7900
      RELGA(JBB)=RELPY                                                   MULC7910
      AENDT1=0.0                                                         MULC7920
      AENDT2=0.0                                                         MULC7930
      DO 1520 I=1,KAA                                                    MULC7940
 1460 IF (XTABT(I)-100000.) 1470,1520,1520                               MULC7950
 1470 IF (XTABT(I)-TIMA(JBB)) 1480,1520,1520                             MULC7960
 1480 AENDT2=AENDT2+TIMA(JBB)-XTABT(I)                                   MULC7970
      JBB1=JBB-1                                                         MULC7980
      IF (JBB1) 1500,1500,1490                                           MULC7990
 1490 IF (TIMA(JBB1)-XTABT(I)) 1500,1500,1510                            MULC8000
 1500 AENDT1=AENDT1+TIMA(JBB)-XTABT(I)                                   MULC8010
      GO TO 1520                                                         MULC8020
 1510 AENDT1=AENDT1+TIMA(JBB)-TIMA(JBB1)                                 MULC8030
 1520 CONTINUE                                                           MULC8040
      TT3=TT3+TT2(JBB)                                                   MULC8050
      UP3=UP3+UP2(JBB)                                                   MULC8060
      REDAC2=REDAC2+REDAC1(JBB)                                          MULC8070
      RED1=(UP2(JBB)-AENDT1+REDAC1(JBB))/TT2(JBB)                        MULC8080
      RED2=(UP3-AENDT2+REDAC2)/TT3                                       MULC8090
 1530 WRITE (6,1540) RED1,RED2                                           MULC8100
 1540 FORMAT (9X16HREADINESS       ,9X4H IS ,F6.4,3X25HREADINESS         MULC8110
     1       ,2X4H IS ,F6.4)                                             MULC8120
      AVA1=UP2(JBB)/TT2(JBB)                                             MULC8130
      AVA2=UP3/TT3                                                       MULC8140
      WRITE (6,1550) AVA1,AVA2                                           MULC8150
 1550 FORMAT (9X23HAVERAGE AVAILABILITY   ,2X4H IS ,F6.4,3X25HAVERAGE AVMULC8160
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     1AILABILITY     ,2X4H IS ,F6.4)                                                  MULC8170
      WRITE (6,1560) XAV                                                            MULC8180
 1560 FORMAT (47X20HINSTANT AVAILABILITY,5X2X4H IS ,F6.4)                           MULC8190
 1570 CONTINUE                                                                      MULC8200
 1580 KKK=1                                                                         MULC8210
      JBB=JBB+1                                                                     MULC8220
      T1=SSTIME(LL,N,1)                                                             MULC8230
 1590 RETURN                                                                        MULC8240
      END                                                                           MULC8250
C                                                                                   MULC8260
CC                                                                                  MULC8270
C                                                                                   MULC8280
      SUBROUTINE PACK                                                               MULC8290
      COMMON /ALPHA/DNT2,ENDPHA,ICRI,IFF,IFR,INUM,IOPT,JBB,KEQ,KKK,KZZ              MULC8300
     1,KK1,KS1,LL,LLLAST,NEQ,NPH,NTYPE,NUM,REDAD2,REDAD1(100),RELP,RED2             MULC8310
     2,RELPY,REPOL,STPHAS,TP,T1,XCUM,TT3,UP3,IFFEOP,T3,TIME,T3SUM                   MULC8320
      COMMON/BETA/NRO(6,300),IB(6,300,8),NLINE(6)                                   MULC8330
      COMMON/EXTRA/ KS(20),ISW(31)                                                  MULC8340
      COMMON /N/IEQU(500),KEQU(500),ETIME(1000),XMTBF(200),XMTTR(200)               MULC8350
      COMMON/NPH/ NSS(6),IFLAG(6),TITLE(6,31),SSTIME(6,31,2),ISS(6,31)              MULC8360
      COMMON /TYP/EX(2,200),ISPARE(3,200),IUSED(3,200),IIUSED(3,200)                MULC8370
      COMMON /MAX/MAXNEQ,MAXTYP,MAXIB,MAXSTD                                        MULC8380
      COMMON/VDC/VCC(50,6),IUI(200),VMTTR(200,6),TAD2                               MULC8390
      COMMON /PACKAP/ IBNUM( 6,500),ISYS( 6),F(200,4)                               MULC8400
      COMMON/STAN/ISTB(60,10,6)                                                     MULC8410
      COMMON /CSPARE/ SPR1,SPR2,SPR3,SPR4,SPR5,SPR6,SPR7,SPR8,SPR9                  MULC8420
     1,SPR10,SPR11,SPR12,SPR13,SPR14,ITMPOP(200)                                    MULC8430
      COMMON/MULTI/MAXC,MULTC,MFLAG,IOPTM,IRC,IOPTP1                                MULC8440
      COMMON/NS/NUMSS(30),NRSHPS,ITOTEQ,NSSEQ(500),NRWCS                            MULC8450
      DIMENSION LCAD(19)                                                            MULC8460
      DIMENSION DUM(4)                                                              MULC8470
      DIMENSION IVAL(10)                                                            MULC8480
      DATA IBLANK/4H    /                                                           MULC8490
C                                                                                   MULC8500
      READ (5,10) KOPT,(KS(I),I=1,13)                                               MULC8510
      WRITE (6,20) KOPT,(KS(I),I=1,13)                                              MULC8520
   10 FORMAT (20I4)                                                                 MULC8530
   20 FORMAT (1H1,I10,5X19I4)                                                       MULC8540
C                                                                                   MULC8550
      READ (5,10) (IFLAG(I),I=1,NPH)                                                MULC8560
      WRITE (6,30) (IFLAG(I),I=1,NPH)                                               MULC8570
   30 FORMAT (10I4)                                                                 MULC8580
C                                                                                   MULC8590
      READ(5,40) REPOL,TAD2,XM,XM1                                                  MULC8600
   40 FORMAT(F4.0,F8.0,2F4.0)                                                       MULC8610
   50 FORMAT(20F4.0)                                                                MULC8620
      IF(XM) 35,35,55                                                               MULC8630
   35 XM=1.0                                                                        MULC8640
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   55 IF(XM1) 36,36,56                                                  MULC8650
   36 XM1=1.                                                            MULC8660
   56 WRITE(6,60) REPOL,TAD2,XM,XM1                                     MULC8670
   60 FORMAT(1X,4F10.2)                                                 MULC8680
      GO TO (70,90,100,120,130),KOPT                                    MULC8690
C                                                                       MULC8700
   70 KS(1)=1                                                           MULC8710
      KS(4)=0                                                           MULC8720
   80 KS(3)=0                                                           MULC8730
      KS(2)=0                                                           MULC8740
      KS(2)=1                                                           MULC8750
      KS(5)=0                                                           MULC8760
      KS(6)=0                                                           MULC8770
      KS(7)=0                                                           MULC8780
      KS(8)=0                                                           MULC8790
      KS(9)=0                                                           MULC8800
      KS(10)=0                                                          MULC8810
      GO TO 130                                                         MULC8820
   90 KS(1)=1                                                           MULC8830
      KS(6)=0                                                           MULC8840
      KS(10)=0                                                          MULC8850
      GO TO 110                                                         MULC8860
  100 KS(1)=1                                                           MULC8870
      KS(6)=1                                                           MULC8880
      KS(7)=1                                                           MULC8890
      KS(10)=1                                                          MULC8900
      KS(12)=1                                                          MULC8910
  110 KS(2)=1                                                           MULC8920
      KS(3)=1                                                           MULC8930
      KS(4)=1                                                           MULC8940
      KS(5)=1                                                           MULC8950
      KS(7)=0                                                           MULC8960
      KS(8)=1                                                           MULC8970
      KS(9)=1                                                           MULC8980
      GO TO 130                                                         MULC8990
  120 KS(1)=0                                                           MULC9000
      KS(4)=0                                                           MULC9010
      GO TO 80                                                          MULC9020
C                                                                       MULC9030
  130 NEQ=0                                                             MULC9040
      DO 140 I=1,MAXNEQ                                                 MULC9050
      ETIME(I)=100000.                                                  MULC9060
      IEQU(I)=0                                                         MULC9070
  140 CONTINUE                                                          MULC9080
      DO 155 J=1,6                                                      MULC9090
      DO 150 I=1,MAXTYP                                                 MULC9100
      XMTBF(I)=0.0                                                      MULC9110
      VMTTR(I,J)=0.0                                                    MULC9120
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  150 XMTTR(I)=0.C                                                                MULC9130
  155 CONTINUE                                                                    MULC9140
C                                                                                 MULC9150
  160 WRITE (6,170)                                                               MULC9160
  170 FORMAT (/11H TYPE  NAME,18X4HMTBF,5X4HMTTR,7X2HDC,8X4HADT1,4X4HADTMULC9170
     12)                                                                          MULC9180
  180 READ (5,190) I,(DUM(J),J=1,4),X,Y,L,V,W,IDUM                                MULC9190
  190 FORMAT (I4,4A4,F8.0,4F4.0,I4)                                               MULC9200
      IF (I) 200,490,200                                                          MULC9210
  200 IF (I-MAXTYP) 220,220,210                                                   MULC9220
  210 WRITE (6,440)                                                               MULC9230
      GO TO 1000                                                                  MULC9240
  220 DO 230 J=1,4                                                                MULC9250
  230 F(I,J)=DUM(J)                                                               MULC9260
      IUI(I)=IDUM                                                                 MULC9270
      IF (IUI(I)) 240,250,240                                                     MULC9280
  240 READ (5,450) IU,(VDC(IU,ILL),ILL=1,NPH)                                     MULC9290
  250 IF (Y) 260,280,280                                                          MULC9300
  260 READ (5,50) (VMTTR(I,J),J=1,NPH)                                            MULC9310
  270 IF (I) 280,490,280                                                          MULC9320
  280 EX(1,I)=V                                                                   MULC9330
      EX(2,I)=W                                                                   MULC9340
      IF (KS(1)) 310,310,290                                                      MULC9350
  290 WRITE (6,300) I,(F(I,J),J=1,4),X,Y,U,V,W                                    MULC9360
  300 FORMAT (1XI4,2X4A4,2XF10.1,F10.2,F10.3,2(F8.1))                             MULC9370
  310 IF (IUI(I)) 380,380,320                                                     MULC9380
  320 IF (KS(1)) 340,340,330                                                      MULC9390
  330 WRITE (6,460) (VDC(IU,ILL),ILL=1,NPH)                                       MULC9400
  340 DO 370 ILL=1,NPH                                                            MULC9410
      IF (VDC(IU,ILL)) 360,360,350                                                MULC9420
  350 VDC(IU,ILL)=(X/VDC(IU,ILL))*XM                                              MULC9430
      GO TO 370                                                                   MULC9440
  360 VDC(IU,ILL)=(X/.COC1)*XM                                                    MULC9450
  370 CONTINUE                                                                    MULC9460
  380 IF (KS(1)) 410,410,390                                                      MULC9470
  390 IF (Y) 400,410,410                                                          MULC9480
  400 WRITE (6,470) (VMTTR(I,J),J=1,NPH)                                          MULC9490
  410 IF (XMTBF(I)) 420,430,420                                                   MULC9500
  420 WRITE (6,480) I                                                             MULC9510
      GO TO 1000                                                                  MULC9520
  430 IF(U) 435,435,433                                                           MULC9530
  433 XMTBF(I)=XM*(X/U)                                                           MULC9540
  435 XMTTR(I)=Y*XM1                                                              MULC9550
      GO TO 180                                                                   MULC9560
  440 FORMAT (9X35HEQUIP TYPES HAVE EXCEEDED MAX ALLOWABLE)                       MULC9570
  450 FORMAT (I4,19(F4.0))                                                        MULC9580
  460 FORMAT (14X16HVARY DUTY CYCLE ,4F10.3)                                      MULC9590
  470 FORMAT (14X16HVARIABLE MTTR   ,4F10.3)                                      MULC9600
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  480 FORMAT (1X4HTYPE,I5,1X13HDEFINED TWICE)                                    MULC9610
C                                                                                MULC9620
  490 WRITE (6,500)                                                              MULC9630
  500 FORMAT (/1X15HTYPE  EQUIPMENT)                                             MULC9640
  510 READ (5,10) NTYPE,(LOAD(I),I=1,19)                                         MULC9650
      IF (LOAD(1)) 520,650,520                                                   MULC9660
  520 DO 620 I=1,19                                                              MULC9670
      IF (LOAD(I)) 530,620,530                                                   MULC9680
  530 IBM=LOAD(I)                                                                MULC9690
      IF (IBM-500) 560,560,540                                                   MULC9700
  540 WRITE (6,550)                                                              MULC9710
  550 FORMAT(1X,'EQUIPMENT NUMBER GREATER THAN 500 ******************')          MULC9720
      GO TO 1000                                                                 MULC9730
  560 IF (IBM-NEQ) 580,580,570                                                   MULC9740
  570 NEQ=IBM                                                                    MULC9750
  580 IF (IEQU(IBM)) 590,610,590                                                 MULC9760
  590 WRITE (6,600) IBM                                                          MULC9770
      GO TO 1000                                                                 MULC9780
  600 FORMAT (1X9HEQUIPMENT,I5,1X34HDEFINED TWICE **********************)        MULC9790
  610 CONTINUE                                                                   MULC9800
      IEQU(IBM)=NTYPE                                                            MULC9810
  620 CONTINUE                                                                   MULC9820
                                                                                 MULC9830
      IF (KS(1)) 640,640,630                                                     MULC9840
  630 WRITE (6,10) NTYPE,(LOAD(I),I=1,19)                                        MULC9850
  640 NTY=NTYPE                                                                  MULC9860
      GO TO 510                                                                  MULC9870
C  **  BUNKER ADDS                                                              MULC9880
  650 NTYPE=NTY                                                                  MULC9890
      IF (ICPTM .EQ. 1) GO TO 740                                                MULC9900
      WRITE(6,660)                                                               MULC9910
C 650 WRITE (6,660)                                                              MULC9920
C  **  BUNKER STOPS                                                             MULC9930
  660 FORMAT(/1X11HSPARES TYPE,6X4HSHIP,4X6HTENDER,6X4HBASE,12X6HFACTOR)         MULC9940
      DO 670 I=1,3                                                               MULC9950
      DO 670 J=1,NTYPE                                                           MULC9960
  670 IUSED(I,J)=0                                                               MULC9970
      READ(5,675)IUNLIM,SX,SPR1,SPR2,SPR3,SPR4,SPR5,SPR6,SPR7,SPR8,SPR9          MULC9980
     1,SPR10,SPR11,SPR12,SPR13,SPR14                                             MULC9990
  675 FORMAT(A4,16X,15F4.0)                                                      MUL10000
      IF(SX-999.) 681,676,681                                                    MUL10010
  676 CALL SPARES                                                                MUL10020
      IF(KS(1)) 740,740,677                                                      MUL10030
  677 DO 678 I=1,NTYPE                                                           MUL10040
  678 WRITE(6,750) I,(ISPARE(J,I),J=1,3),SX                                      MUL10050
      GO TO 740                                                                  MUL10060
  681 IF(SX) 684,682,684                                                         MUL10070
  682 SX=1.0                                                                     MUL10080
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  684 IF(IUNLIM-IBLANK)690,720,690                                          MUL10090
  690 WRITE (6,700)                                                         MUL10100
  700 FORMAT (1X41HALL EQUIPMENT TYPES HAVE UNLIMITED SPARES)               MUL10110
      DO 710 I=1,NTYPE                                                      MUL10120
      DO 710 J=1,3                                                          MUL10130
  710 ISPARE(J,I)=90000                                                     MUL10140
      GO TO 760                                                             MUL10150
  720 DO 740 I=1,NTYPE                                                      MUL10160
      READ (5,10) (ISPARE(J,I),J=1,3)                                       MUL10170
      BILL=FLOAT(ISPARE(1,I))*SX                                            MUL10180
      IF(INT(BILL)-BILL) 727,725,727                                        MUL10190
  725 ISPARE(1,I)=BILL                                                      MUL10200
      GO TO 728                                                             MUL10210
  727 ISPARE(1,I)=INT(BILL)+1                                               MUL10220
  728 CONTINUE                                                              MUL10230
      IF (KS(1)) 740,740,730                                                MUL10240
  730 WRITE(6,750)I,(ISPARE(J,I),J=1,3),SX                                  MUL10250
  740 CONTINUE                                                              MUL10260
  750 FORMAT(5X,I4,2X,3I10,13X,F6.2)                                        MUL10270
C                                                                           MUL10280
  760 WRITE (6,770) NPH                                                     MUL10290
  770 FORMAT (1H1,3X28HTHE MISSION WILL BE RUN WITH,I4,7H PHASE ,27HTYPE    MUL10300
     1S IN VARIABLE SEQUENCE.)                                              MUL10310
C                                                                           MUL10320
      DO 777 I=1,6                                                          MUL10330
      DO 776 J=1,10                                                         MUL10340
      DO 775 K=1,60                                                         MUL10350
      ISTB(K,J,I)=0                                                         MUL10360
  775 CONTINUE                                                              MUL10370
  776 CONTINUE                                                              MUL10380
  777 CONTINUE                                                              MUL10390
      DO 990 K=1,NPH                                                        MUL10400
      READ (5,780) XID,LL,NSS(K),ISS(K,NSS(K)+1),SSTIME(K,NSS(K)+1,2)       MUL10410
      ISYS(K)=ISS(K,NSS(K)+1)                                               MUL10420
  780 FORMAT (A4,3I4,F8.0)                                                  MUL10430
      NX=NSS(K)                                                             MUL10440
      N=NX+1                                                                MUL10450
      IF (KS(1)) 820,820,790                                                MUL10460
  790 WRITE (6,810) XID,LL,NSS(K),ISS(K,N),SSTIME(K,N,2)                    MUL10470
  800 FORMAT (1XA4,3I4,F10.2)                                               MUL10480
  810 FORMAT (/1XA4,3I4,F10.2)                                              MUL10490
  820 TITLE(K,N)=XID                                                        MUL10500
C                                                                           MUL10510
      DO 840 IK=1,NX                                                        MUL10520
      READ (5,780) TITLE(K,IK),KK,MM,ISS(K,IK),SSTIME(K,IK,2)               MUL10530
      IF (KS(1)) 840,840,830                                                MUL10540
  830 WRITE (6,800) TITLE(K,IK),LL,MM,ISS(K,IK),SSTIME(K,IK,2)              MUL10550
  840 CONTINUE                                                              MUL10560
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C  **  BUNKER ADDS                                                    MUL10570
      IF(IOPTM.NE.1)GO TO 846                                         MUL10580
      DO 845 I=1,ITOTEC,18                                            MUL10590
  845 READ(5,847)(NSSEC(I+J-1),J=1,18)                                MUL10600
  846 CONTINUE                                                        MUL10610
  847 FORMAT(18I4)                                                    MUL10620
C  **  BUNKER STOPS                                                   MUL10630
      DO 850 JA=1,MAXIB                                               MUL1064C
      DO 850 JB=1,8                                                   MUL10650
      IB(K,JA,JB)=C                                                   MUL10660
      NRO(K,JA)=0                                                     MUL10670
  850 CONTINUE                                                        MUL10680
      IOR=0                                                           MUL10690
      I=0                                                             MUL10700
  860 I=I+1                                                           MUL10710
      READ(5,10) (IVAL(J),J=1,10),IRULE                               MUL10720
      IF(IVAL(1).EC.0) GC TC  990                                     MUL10730
      IF(IRULE.NE.C)GOTO 930                                          MUL10740
C                                                                     MUL10750
      IF(I.LE.MAXIB) GC TO 880                                        MUL10760
      WRITE(6,870) MAXIB                                              MUL10770
  870 FORMAT(1H1,10X,29H# CF GROUP CARDS GREATER THAN,I4)             MUL10780
      STOP                                                            MUL10790
  880 NRO(K,I)=IVAL(1)                                                MUL10800
C                                                                     MUL10810
      DO 890 J=1,8                                                    MUL10820
      IB(K,I,J)=IVAL(J+1)                                             MUL10830
  890 CONTINUE                                                        MUL10840
      IBNUM(K,IB(K,I,1)-500)=I                                        MUL10850
      NLINE(K)=I                                                      MUL10860
  900 IF(KS(1)) 860,860,910                                           MUL10870
  910 WRITE(6,920) NRC(K,I),(IB(K,I,J),J=1,8)                         MUL10880
  920 FORMAT(1X,I3,8I4)                                               MUL10890
      GO TO 860                                                       MUL10900
  930 CONTINUE                                                        MUL10910
      I=I-1                                                           MUL10920
      IOR=ICR+1                                                       MUL10930
C                                                                     MUL10940
      IF(IOR.LE.MAXSTD) GO TO 950                                     MUL10950
      WRITE(6,940) MAXSTD                                             MUL10960
  940 FORMAT(1H1,10X,36H# OF OPERATE RULE CARDS GREATER THAN,I4)      MUL10970
      STOP                                                            MUL10980
  95C CONTINUE                                                        MUL10990
      DO 960 J=1,10                                                   MUL11000
      ISTB(IOR,J,K)=IVAL(J)                                           MUL11010
  960 CONTINUE                                                        MUL11020
      IF(KS(1)) 860,860,970                                           MUL11030
  97C WRITE(6,980) (ISTB(IOR,J,K),J=1,10)                             MUL11040
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  980 FORMAT(30X,10I4)                                                    MUL11050
      GO TO 860                                                           MUL11060
  990 CONTINUE                                                            MUL11070
 1000 CONTINUE                                                            MUL11080
      RETURN                                                              MUL11090
      END                                                                 MUL11100
C                                                                         MUL11110
CCC                                                                       MUL11120
CCC                                                                       MUL11130
C                                                                         MUL11140
      SUBROUTINE EVENT                                                    MUL11150
      COMMON /ALPHA/DNT2,ENDPHA,ICRI,IFF,IFR,INUM,IOPT,JBB,KEQ,KKK,KZZ    MUL11160
     1,KK1,KS1,LL,LLLAST,NEC,NPH,NTYPE,NUM,REDAD2,REDAD1(100),RELP,RED2   MUL11170
     2,RELPY,REPOL,STPHAS,TP,T1,XCUM,TT3,UP3,IFFEOP,T3,TIME,T3SUM         MUL11180
      COMMON /N/IECU(500),KEQU(500),ETIME(1000),XMTBF(200),XMTTR(200)     MUL11190
      COMMON/MULTI/MAXC,MULTC,MFLAG,IOPTM,IRC,IOPTP1                      MUL11200
C                                                                         MUL11210
      R=ABS(ETIME(1))                                                     MUL11220
      KEQ=1                                                               MUL11230
      DO 20 I=2,NEC                                                       MUL11240
      RR=ABS(ETIME(I))                                                    MUL11250
      IF (R-RR) 20,20,10                                                  MUL11260
   10 R=RR                                                                MUL11270
      KEQ=I                                                               MUL11280
   20 CONTINUE                                                            MUL11290
      RETURN                                                              MUL11300
      END                                                                 MUL11310
C                                                                         MUL11320
CC                                                                        MUL11330
C                                                                         MUL11340
      SUBROUTINE TTE                                                      MUL11350
      COMMON /ALPHA/DNT2,ENDPHA,ICRI,IFF,IFR,INUM,IOPT,JBB,KEQ,KKK,KZZ    MUL11360
     1,KK1,KS1,LL,LLLAST,NEC,NPH,NTYPE,NUM,REDAD2,REDAD1(100),RELP,RED2   MUL11370
     2,RELPY,REPOL,STPHAS,TP,T1,XCUM,TT3,UP3,IFFEOP,T3,TIME,T3SUM         MUL11380
      COMMON /N/IECU(500),KEQU(500),ETIME(1000),XMTBF(200),XMTTR(200)     MUL11390
      COMMON/EXTRA/ KS(20),ISW(31)                                        MUL11400
      COMMON/NPH/ NSS(6),IFLAG(6),TITLE(6,31),SSTIME(6,31,2),ISS(6,31)    MUL11410
      COMMON /TYP/EX(2,200),ISPARE(3,200),IUSED(3,200),IIUSED(3,200)      MUL11420
      COMMON /DELTA/KKK2                                                  MUL11430
      COMMON /XXX/XXX                                                     MUL11440
      COMMON/VDC/VDC(50,6),IUI(200),VMTTR(200,6),TAD2                     MUL11450
      COMMON /GAMMAA/XMTBA,VAR,RELGA(100),TIMA(100),XXT(200),ITT,ISEED    MUL11460
      COMMON/MULTI/MAXC,MULTC,MFLAG,IOPTM,IRC,IOPTP1                      MUL11470
      COMMON/NS/NUMSS(30),NRSHPS,ITOTEQ,NSSEQ(500),NRWCS                  MUL11480
C                                                                         MUL11490
C   **  BUNKER ADDS                                                       MUL11500
      ADT = 0.                                                            MUL11510
C   **  BUNKER ADDS                                                       MUL11520
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   10 K=KEQ                                                                  MUL11530
   20 J=IABS(IEQU(K))                                                        MUL11540
      IF (ETIME(K)-100000.) 30,120,30                                        MUL11550
C  **  BUNKER ADDS                                                           MUL11560
   30 IF (ETIME(K)) 120,120,35                                               MUL11570
C  30 IF (ETIME(K)) 120,120,40                                               MUL11580
   35 IF(IOPTM .EQ. 0) GO TO 40                                              MUL11590
      CALL MULTE(KEQ,ETIME(K),J,NTYPE,NUM,  ACT)                             MUL11600
      GO TO 120                                                              MUL11610
C  **  BUNKER STOPS                                                          MUL11620
   40 IF (ABS(XXX)-9999.) 41,120,41                                          MUL11630
   41 DO 60 I=1,2                                                            MUL11640
      IF (ISPARE(I,J)-IUSED(I,J)) 60,60,50                                   MUL11650
   50 IUSED(I,J)=IUSED(I,J)+1                                                MUL11660
      IIUSED(I,J)=IIUSED(I,J)+1                                              MUL11670
      II=I                                                                   MUL11680
      GO TO 120                                                              MUL11690
   60 CONTINUE                                                               MUL11700
      IF (ISPARE(3,J)-IUSED(3,J)) 70,70,110                                  MUL11710
   70 IF (ETIME(K)-100000.) 80,120,80                                        MUL11720
   80 ETIME(K)=-500000.                                                      MUL11730
      IF (KS(12)) 340,340,90                                                 MUL11740
   90 WRITE (6,100) J                                                        MUL11750
  100 FORMAT (1X15HEQUIPMENT TYPE ,I4,25H HAS CONSUMED ALL SPARES.)          MUL11760
      GO TO 340                                                              MUL11770
  110 IUSED(3,J)=IUSED(3,J)+1                                                MUL11780
      IIUSED(3,J)=IIUSED(3,J)+1                                              MUL11790
      II=3                                                                   MUL11800
C                                                                            MUL11810
  120 XXX=ABS(XXX)                                                           MUL11820
C                                                                            MUL11830
      IF (KKK2) 140,130,140                                                  MUL11840
  130 TP=0                                                                   MUL11850
      II=0                                                                   MUL11860
  140 IF (ETIME(K)-100000.) 160,150,160                                      MUL11870
  150 ETIME(K)=-TP                                                           MUL11880
      GO TO 170                                                              MUL11890
  160 IF (ETIME(K)) 170,170,180                                              MUL11900
  170 X=1.                                                                   MUL11910
      GO TO 190                                                              MUL11920
  180 X=-1.                                                                  MUL11930
  190 CALL LRND(ISEED,RN,1,16807,0)                                          MUL11940
C  **  BUNKER ADDS                                                           MUL11950
      IF (ICPTM .EQ. 1) GO TO 220                                            MUL11960
C  **  BUNKER STOPS                                                          MUL11970
      IF (II-2) 200,210,210                                                  MUL11980
  200 ADT=0.                                                                 MUL11990
      GO TO 220                                                              MUL12000
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  210 III=II-1                                                                  MUL12010
      ADT=EX(III,J)                                                             MUL12020
  220 CONTINUE                                                                  MUL12030
      IF (ETIME(K)) 23C,230,330                                                 MUL12040
  230 K1=IABS(IEQU(K))                                                          MUL12050
      IF (IUI(K1)) 33C,330,240                                                  MUL12060
  240 IU=IUI(K1)                                                                MUL12070
      ST=0.C                                                                    MUL12080
      SR=1.0                                                                    MUL12090
      RN3=RN                                                                    MUL12100
      DO 31C I=JBB,100                                                          MUL12110
      T=XXT(2*I)                                                                MUL12120
      IF (T) 250,320,250                                                        MUL12130
  250 IF (ST) 300,260,300                                                       MUL12140
  260 T=TIMA(I)+ETIME(K)                                                        MUL12150
      IF (T) 270,310,3C0                                                        MUL12160
  270 T=0                                                                       MUL12170
      GO TO 310                                                                 MUL12180
  300 LLL=XXT(2*I-1)                                                            MUL12190
      XM=VDC(IU,LLL)                                                            MUL12200
      IF (XM) 280,320,280                                                       MUL12210
  280 R=EXP(-T/XM)                                                              MUL12220
      SR=SR*R                                                                   MUL12230
      IF (SR-RN) 320,320,290                                                    MUL12240
  290 ST=ST+T                                                                   MUL12250
      RN3=RN/SR                                                                 MUL12260
  310 CONTINUE                                                                  MUL12270
  320 ETIME(K)=ST-(XM*ALOG(RN3))+ABS(ETIME(K))+ADT                              MUL12280
      GO TO 340                                                                 MUL12290
  330 ETIME(K)=X*(-XXX*ALOG(RN)+ABS(ETIME(K))+ADT)                              MUL12300
  340 IF (IFLAG(LL)-1) 370,370,350                                              MUL12310
  350 IF (ETIME(K)+500000.) 360,370,360                                         MUL12320
  360 ETIME(K)=100000.                                                          MUL12330
  370 CONTINUE                                                                  MUL12340
      RETURN                                                                    MUL12350
      END                                                                       MUL12360
C                                                                               MUL12370
C                                                                               MUL12380
C                                                                               MUL12390
C                                                                               MUL12400
C                                                                               MUL12410
C                                                                               MUL12420
C                                                                               MUL12430
      SUBROUTINE STNDBY                                                         MUL12440
      COMMON /ALPHA/ENT2,ENDPHA,IER1,IFF,IFR,INUM,IOPT,JBB,KEQ,KKK,KZZ          MUL12450
     1,KK1,KS1,LL,LLLAST,NEC,NPH,NTYPE,NUM,REDAD2,REDAD1(100),RELP,RED2         MUL12460
     2,RELPY,REPOL,STPHAS,TP,T1,XCUM,TT3,UP3,IFFEOP,T3,TIME,T3SUM               MUL12470
      COMMON /N/IEQU(500),KEQU(500),ETIME(1000),XMTBF(200),XMTTR(200)           MUL12480
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      PRBSUM=PRBSUM+DUM*(EX90DD**K)/KFACT                                MUL15370
      IF(PRBSUM-XAVAIL) 40,50,50                                         MUL15380
   50 ISPARE(1,I)=K                                                      MUL15390
      GO TO 90                                                           MUL15400
   60 IF(4.*EX90DC-CUT) 80,80,70                                         MUL15410
C                                                                        MUL15420
   70 ISPARE(1,I)=1                                                      MUL15430
      GO TO 90                                                           MUL15440
   80 ISPARE(1,I)=C                                                      MUL15450
   90 CONTINUE                                                           MUL15460
      DO 100 I=1,NTYPE                                                   MUL15470
      DO 100 J=2,3                                                       MUL15480
      ISPARE(J,I)=0                                                      MUL15490
  100 CONTINUE                                                           MUL15500
      RETURN                                                             MUL15510
      END                                                                MUL15520
C                                                                        MUL15530
C                                                                        MUL15540
C                                                                        MUL15550
C                                                                        MUL15560
C                          SUBROUTINE MULTE                              MUL15570
C*************************************************************         MUL15580
C**                                                         **         MUL15590
C**  SUBROUTINE 'MULTE' SIMULATES A MULTI-ECHELON SUPPLY NETWORK  **     MUL15600
C**  WITH VARIABLE RESUPPLY CHANNELS.  IT RECORDS AND MOITORS ALL **     MUL15610
C**  SUPPLY ACTIONS RESULTING FROM AN EQUIPMENT FAILURE IN THE    **     MUL15620
C**  'TIGER' SIMULATION.  IT PROVIDES 'TIGER' WITH A SUPPLY       **     MUL15630
C**  RESPONSE TIME WHICH IS RETURNED TO THE 'TTE' SUBROUTINE AND  **     MUL15640
C**  ADDED TO THE EQUIPMENT'S TIME-TO-REPAIR.  'MULTE' WILL ALSO  **     MUL15650
C**  OUTPUT VARIOUS DATA AND INFORMATIONAL SUMMARIES UPON COMPLE- **     MUL15660
C**  TION OF ALL MISSIONS (SEE DOCUMENTATION FOR FURTHER DETAILS). **    MUL15670
C**                                                         **         MUL15680
C*************************************************************         MUL15690
C                                                                        MUL15700
C                                                                        MUL15710
C                                                                        MUL15720
      SUBROUTINE MULTE(KEQ,CTIME,EQTYP,NTY,NUM,  SRT)                    MUL15730
C                                                                        MUL15740
      COMMON/STAT/XD(200,4),XT(4),XG,SUMD(200,4),SUMXD(200,4)            MUL15750
      COMMON/ISTAT/NIST,NMFR(200,4,2),NNN(200,4,3),NRA,NRRT,             MUL15760
     1NRF(200,4,2),NSHIP(14,14),IXD(200,4),IXT(4),IXG                    MUL15770
      COMMON/MAX/MAXNEC,MAXTYP,MAXIB,MAXSTD                              MUL15780
      COMMON/MULTI/MAXC,MULTC,MFLAG,IOPTM,IRC,IOPTP1                     MUL15790
      COMMON/MP/CRAR,ALFA1,ALFA2,SSRT,ECCST(200),OSTSR(6),OSTM(11),      MUL15800
     1OST(2,11,4)                                                        MUL15810
      COMMON/NS/NUMSS(30),NRSHPS,ITOTEQ,NSSEQ(500),NRWCS                 MUL15820
      INTEGER COAST,DESTN,DTOT,DUEN,DUES,ECH,EQTYP,OQICP,REQN,SHIPR,     MUL15830
     1SHPR,SHLOC,SSN,TC,RORD,RP,ENUSE                                    MUL15840
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      INTEGER DELCH(4),DUEA(1000),DUEE(1000),DUEQ(1000),ERQ(200),          MUL15850
     1HILIM(38,200),IDUEJ(3,10),IP(38,200),LEVEL(35),ONHND(38,200),       MUL15860
     2OPMOD(6),OQREQ(3),ORACT(10),ORDER(3),ORDQT(10),REORD(38,200),       MUL15870
     3RESON(10),RPAIR(200)                                                MUL15880
      REAL A(100),DUET(1000),MIN,MPLT(200),MSD,MSDT,MRT(200)              MUL15890
C                                                                          MUL15900
      DATA LEVEL/30*1,2*2,3,2*4/,IX1/2954783/,                             MUL15910
     1IX2/9483948/,IX3/78594/,IX4/294753/                                 MUL15920
      MSD = 0.0                                                            MUL15930
      SRT = 0.0                                                            MUL15940
      REQN = 0                                                             MUL15950
      DTOT = 0                                                             MUL15960
      DO 1 I = 1,4                                                         MUL15970
         DELCH(I) = 0                                                      MUL15980
    1 CONTINUE                                                             MUL15990
      IF(MFLAG .NE. 0) GO TO 3                                             MUL16000
C                                                                          MUL16010
C**   ON FIRST CALL TO 'MULTE' READ/PRINT INPUT DATA, AND CALCULATE        MUL16020
C**   INITIAL INVENTORY INVESTMENT LEVELS.  AT THE BEGINNING OF EACH       MUL16030
C**   MISSION RESET PARAMETERS AS APPROPRIATE. (SUBR MPACK)                MUL16040
C                                                                          MUL16050
      CALL MPACK(ERQ,HILIM,IP,ONHND,MPLT,MRT,MSDT,REORD,                   MUL16060
     1RPAIR,OTIME,DUEA,DUEE,DUEQ,DUET,DUEN,NTY)                           MUL16070
C                                                                          MUL16080
    3 MULTC = MULTC + 1                                                    MUL16090
C                                                                          MUL16100
C**   DETERMINE SHIP IN WHICH FAILURE OCCURED, ITS OPERATING MODE AND      MUL16110
C**   LOCATION.                                                            MUL16120
      IF(NSSEQ(KEQ).GT.NRWCS) GO TO 5                                      MUL16130
      ISHIP=NSSEQ(KEQ)+869                                                 MUL16140
      GO TO 6                                                              MUL16150
    5 ISHIP=NSSEQ(KEQ)+884-NRWCS                                           MUL16160
    6 COAST = 1                                                            MUL16170
      IF(ISHIP .GE. 885)  COAST = 2                                        MUL16180
      SHLOC = IRC                                                          MUL16190
      IF(COAST .EQ. 2) SHLOC = SHLOC + 3                                   MUL16200
C                                                                          MUL16210
C**   IF EQUIPMENT IS DESIGNATED AS A REPAIRABLE, RETURN FAILED UNIT       MUL16220
C**   TO APPROPRIATE REPAIR FACILITY.                                      MUL16230
C                                                                          MUL16240
      IF(RPAIR(EQTYP))24,24,10                                             MUL16250
C                                                                          MUL16260
C**   DETERMINE IF THIS CARCASS IS LOST THROUGH ATTRITION.                 MUL16270
C                                                                          MUL16280
   10 CALL LRND(IX1,A,1,1,0)                                               MUL16290
      IF(A(1) .LE. CRAR) GO TO 12                                          MUL16300
      SSN = 37                                                             MUL16310
      IF(COAST .EQ. 2) SSN = 36                                            MUL16320
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C                                                                       MUL16330
CC   **  ESTABLISH A DUE-IN AT REPAIR FACILITY.                         MUL16340
C                                                                       MUL16350
      DTIME = CSTSR(SHLOC) + CTIME                                      MUL16360
      CALL ESDUE(SSN,EQTYP,DTIME,1,DUEN,DUEA,DUEE,DUEQ,DUET)            MUL16370
      NRRT = NRRT + 1                                                   MUL16380
      GO TO 15                                                          MUL16390
C                                                                       MUL16400
CC   **  CARCASS LOSS DUE TO ATTRITION, REDUCE ICP INV POSITION.        MUL16410
C                                                                       MUL16420
   12 IP(38,EQTYP) = IP(38,EQTYP) - 1                                   MUL16430
      IS = ISHIP-869                                                    MUL16440
      IF(IOPTP1 .EQ. 0) GO TO 14                                        MUL16450
      WRITE(6,600)EQTYP,IS                                              MUL16460
  600 FORMAT('0',5X,'REPAIRABLE EQ NR',I4,' WAS NOT RECEIVED BY REPAIR FMUL16470
     1ACILITY FROM SHIP NR',I3,' DUE TO ATTRITION.')                    MUL16480
   14 NRA = NRA + 1                                                     MUL16490
   15 CONTINUE                                                          MUL16500
C                                                                       MUL16510
C   **  IF SUFFICIENT CARCASSES ARE AVAILABLE AT REPAIR FACILITIES,     MUL16520
C   **  INDUCT ERQ AND DISTRIBUTE TO STOCK POINTS AS APPROPRIATE.       MUL16530
C                                                                       MUL16540
      NEED = -1                                                         MUL16550
      DO 22 I=36,37                                                     MUL16560
C   **  CHECK REPAIR ACTIVITIES FOR CARCASSES DUE IN.                   MUL16570
        CALL CHKDU(I,EQTYP,CTIME,DUEN,DUEA,DUEE,DUEQ,DUET,  DUES)       MUL16580
        ONHND(I,EQTYP) = CNHND(I,EQTYP) + DUES                          MUL16590
        L=1                                                             MUL16600
        ST = 0.0                                                        MUL16610
        IF(ONHND(I,EQTYP) .LT. ERQ(EQTYP)) GO TO 22                     MUL16620
        SSN = 34                                                        MUL16630
        IF(I .EQ.37)SSN = 33                                            MUL16640
        IF(HILIM(34,EQTYP).EQ.0 .AND. I.EQ.36) GO TO 22                 MUL16650
        IF(HILIM(33,EQTYP).EQ.0 .AND. I.EQ.37) SSN = 35                 MUL16660
        IF(SSN.EQ.35 .AND. HILIM(35,EQTYP).EQ.0) GO TO 22               MUL16670
        IF(SSN.EQ.35) GO TO 1601                                        MUL16680
        IF(I .EQ. 37) GO TO 16                                          MUL16690
 1601   RORD = ERQ(EQTYP)                                               MUL16700
        NRF(EQTYP,3,1) = NRF(EQTYP,3,1) + 1                             MUL16710
        NRF(EQTYP,3,2) = NRF(EQTYP,3,2) + RORD                          MUL16720
        CALL LGAMA(IX2,A,RORD,1,0,ALFA1)                                MUL16730
        IF(I.EQ.36 .OR. SSN.EQ.35) GO TO 17                             MUL16740
   16           NEED = HILIM(SSN,EQTYP) - CNHND(SSN,EQTYP)              MUL16750
                RORD = MIN0(NEED,ERQ(EQTYP))                            MUL16760
                NRF(EQTYP,2,1) = NRF(EQTYP,2,1) + 1                     MUL16770
                NRF(EQTYP,2,2) = NRF(EQTYP,2,2) + RORD                  MUL16780
                ST = OST(1,9,3)                                         MUL16790
   17   CONTINUE                                                        MUL16800
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      ICTIME=INT(CTIME)                                                 MUL16810
      IF(IOPTP1 .EQ. 0) GO TO 18                                        MUL16820
      WRITE(6,610)ICTIME,I,EQTYP                                        MUL16830
      WRITE(6,612)                                                      MUL16840
  610 FORMAT('0',2X,'AT TIME',I5,' REPAIR FACILITY',I3,' INDUCTED AN    MUL16850
     XERQ FOR EQUIP TYPE',I4,'.')                                       MUL16860
  612 FORMAT('0',2X,'DUES ESTABLISHED FOR:',8X,'SSN',8X,'DUE TIME'/)    MUL16870
   18 CONTINUE                                                          MUL16880
      DO 20 J=1,RORD                                                    MUL16890
         RTIME = MRT(EQTYP)*A(J)                                        MUL16900
         DTIME = RTIME + CTIME + ST                                     MUL16910
         SHIPR = I - 24                                                 MUL16920
         DESTN = SSN - 24                                               MUL16930
         NSHIP(SHIPR,DESTN)=NSHIP(SHIPR,DESTN) + 1                      MUL16940
         CALL ESDUE(SSN,EQTYP,DTIME,1,DUEN,DUEA,DUEE,DUEQ,DUET)         MUL16950
         IF (IOPTP1 .EQ. 0) GO TO 20                                    MUL16960
         WRITE(6,614)SSN,DTIME                                          MUL16970
  614    FORMAT(32X,I3,8X,F8.0)                                         MUL16980
   20 CONTINUE                                                          MUL16990
      IF(I.EQ.36 .OR. SSN.EQ.35 .OR. NEED.GE.ERQ(EQTYP))GO TO 22        MUL17000
      SSN = 35                                                          MUL17010
      IF(HILIM(SSN,EQTYP) .EQ. 0) GO TO 22                              MUL17020
      L = NEED + 1                                                      MUL17030
      RORD = ERQ(EQTYP)                                                 MUL17040
      NRF(EQTYP,3,1) = NRF(EQTYP,3,1) + 1                               MUL17050
      NRF(EQTYP,3,2) = NRF(EQTYP,3,2) + ERQ(EQTYP) - NEED               MUL17060
      ST = 0.0                                                          MUL17070
      GO TO 18                                                          MUL17080
   22 CONTINUE                                                          MUL17090
   24 CONTINUE                                                          MUL17100
      SSN = (ISHIP-869)                                                 MUL17110
C                                                                       MUL17120
CC   **  IF STOCK DUE-IN'S HAVE ARRIVED, INCREASE ON-HAND QUANTITY.     MUL17130
C                                                                       MUL17140
      CALL CHKDU(SSN,EQTYP,CTIME,DUEN,DUEA,DUEE,DUEQ,DUET, DUES)        MUL17150
      ONHND(SSN,EQTYP) = ONHND(SSN,EQTYP) + DUES                        MUL17160
      DELOH(1) = DELOH(1) + DUES                                        MUL17170
C                                                                       MUL17180
CC   **  IF NO STOCK ON-HAND, PREPARE AND SEND REQUISION TO NEXT ECHELON. MUL17190
C                                                                       MUL17200
      NNN(EQTYP,1,1) = NNN(EQTYP,1,1) + 1                               MUL17210
      IF (ONHND(SSN,EQTYP) .GE. 1) GO TO 30                             MUL17220
         IF(HILIM(SSN,EQTYP) .EQ. 0) GO TO 27                           MUL17230
            NNN(EQTYP,1,2) = NNN(EQTYP,1,2) + 1                         MUL17240
            GO TO 28                                                    MUL17250
   27    NNN(EQTYP,1,3) = NNN(EQTYP,1,3) + 1                            MUL17260
   28    RECN = RECN + 1                                                MUL17270
         RESCN(RECN) = 1                                                MUL17280
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            ORACT(REQN) = SSN                                                   MUL17290
            ORDQT(REQN) = 1                                                     MUL17300
            IP(SSN,EQTYP) = IP(SSN,EQTYP) + 1                                   MUL17310
            GO TO 95                                                            MUL17320
         30 CONTINUE                                                            MUL17330
C                                                                               MUL17340
CC       **  ISSUE ITEM FROM STOCK.  ESTABLISH SRT.                             MUL17350
C                                                                               MUL17360
            ONHND(SSN,EQTYP) = ONHND(SSN,EQTYP) - 1                             MUL17370
            DELOH(1) = DELOH(1) - 1                                             MUL17380
            IP(SSN,EQTYP) = IP(SSN,EQTYP) - 1                                   MUL17390
            NIST = NIST + 1                                                     MUL17400
            SRT=SSRT                                                            MUL17410
            IASRT = SSN                                                         MUL17420
            CALL SWITCH(SRT,SSN,EQTYP,DUEN,DUEA,DUEE,DUEC,DUET)                MUL17430
C                                                                               MUL17440
CC       **  IF IP AT RECRDER POINT, REORDER FCR STOCK FROM NEXT ECHELON        MUL17450
C                                                                               MUL17460
            IF (IP(SSN,EQTYP) .GT. REORD(SSN,EQTYP)) GO TO 35                   MUL17470
            REQN = REQN + 1                                                     MUL17480
            ORACT(REQN) = SSN                                                   MUL17490
            RESON(REQN) = 2                                                     MUL17500
            ORDQT(REQN) = HILIM(SSN,EQTYP) - IP(SSN,EQTYP)                      MUL17510
            IP(SSN,EQTYP) = IP(SSN,EQTYP) + ORDQT(REQN)                         MUL17520
            GO TO 95                                                            MUL17530
         35 CONTINUE                                                            MUL17540
C                                                                               MUL17550
CC       **  IF REQUISITION FILLED AND NO STOCK REQUIREMENT, RETURN TO 'TIGER'  MUL17560
C                                                                               MUL17570
            GO TO 495                                                           MUL17580
C                                                                               MUL17590
CC       **  IRC DETERMINES REQUISITION CHANNELS.                               MUL17600
C                                                                               MUL17610
         95 IF(IRC - 2)100,200,300                                              MUL17620
C                                                                               MUL17630
CC       **  LABEL 100 REFERS TO CONUS SUPPLY CENTERS                           MUL17640
C                                                                               MUL17650
        100 CONTINUE                                                            MUL17660
            ECH = 3                                                             MUL17670
            SSN = 34                                                            MUL17680
            IF(COAST .EQ. 1) SSN = 35                                           MUL17690
C                                                                               MUL17700
CC       **  LABELS 105-130 ARE USED BY ALSF, DEPOT AND CENTERS FOR             MUL17710
CC       **  GENERATING ISSUES AND PASSING PARTIAL OR UNFILLED REQUISITIONS     MUL17720
CC       **  TO NEXT ECHELON.                                                   MUL17730
C                                                                               MUL17740
CC       **  CHECK FOR DUE-IN'S AT ACTIVITY (SSN).                              MUL17750
C                                                                               MUL17760
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  105    CALL CHKDU(SSN,EQTYP,CTIME,DUEN,DUEA,DUEE,DUEQ,DUET, DUES)      MUL17770
         CNHND(SSN,EQTYP) = CNHND(SSN,EQTYP) + DUES                      MUL17780
         DELOH(ECH+1) = DELCH(ECH+1) + DUES                              MUL17790
  110 CONTINUE                                                           MUL17800
      NNN(EQTYP,ECH+1,1) = NNN(EQTYP,ECH+1,1) + 1                        MUL17810
      ISSUE = MIN0(CNHND(SSN,EQTYP),CRDQT(1))                            MUL17820
      IF(ISSUE .EC. 0) GC TC 127                                         MUL17830
      CNHND(SSN,EQTYP) = CNHND(SSN,EQTYP) - ISSUE                        MUL17840
      DELOH(ECH+1) = DELCH(ECH+1) - ISSUE                                MUL17850
C                                                                        MUL17860
CC  **  IP IS DECREMENTED FOR REPAIRABLES CNLY IF ATTRITION OCCURS.      MUL17870
C                                                                        MUL17880
      IF(SSN .EQ. 31 .CR. SSN .EQ. 32) GC TO 112                         MUL17890
         IF(RPAIR(EQTYP) .EC. 0) IP(38,EQTYP)=IP(38,EQTYP) - ISSUE       MUL17900
         GO TO 113                                                       MUL17910
  112 IP(SSN,EQTYP) = IP(SSN,EQTYP) - ISSUE                              MUL17920
  113 CONTINUE                                                           MUL17930
C                                                                        MUL17940
CC  **  DETERMINE SHIPPER ANC SHIPMENT DESTINATION.                      MUL17950
C                                                                        MUL17960
      SHIPR = SSN - 24                                                   MUL17970
      DESTN = SHLCC                                                      MUL17980
      IF(ORACT(1) .GT. 30) DESTN = ORACT(1) - 24                         MUL17990
      NSHIP(SHIPR,DESTN) = NSHIP(SHIPR,DESTN) + 1                        MUL18000
C                                                                        MUL18010
CC  **  IF END USE REQUIREMENT, ESTABLISH SRT.                           MUL18020
C                                                                        MUL18030
      IF(RESCN(1) .EQ. 2) GC TO 115                                      MUL18040
         SRT = OST(COAST,DESTN,ECH)                                      MUL18050
         IF(DESTN .LE. 6) SRT = SRT + MSD                                MUL18060
         IASRT = SSN                                                     MUL18070
         CALL SWITCH(SRT,ORACT(1),EQTYP,DUEN,DUEA,DUEE,DUEQ,DUET)       MUL18080
         GO TO 120                                                       MUL18090
  115 CONTINUE                                                           MUL18100
C                                                                        MUL18110
CC  **  IF REQUISITION IS FOR STOCK, ESTAB DUE-IN AT ORDERING ACTIVITY.  MUL18120
C                                                                        MUL18130
         DTIME = CST(CCAST,DESTN,ECH) + CTIME + SRT                      MUL18140
         IF(DESTN .LE. 6)  CTIME = DTIME + MSD                           MUL18150
         CALL ESDUE(ORACT(1),EQTYP,DTIME,ISSUE,DUEN,DUEA,DUEE,DUEQ,      MUL18160
     1   DUET)                                                           MUL18170
         DTCT = DTCT + 1                                                 MUL18180
         IDUEJ(1,DTOT) = ORACT(1)                                        MUL18190
         IDUEJ(2,DTOT) = INT(DTIME)                                      MUL18200
         IDUEJ(3,DTOT) = SSN                                             MUL18210
  120 CONTINUE                                                           MUL18220
C                                                                        MUL18230
C  **  IF REQUISITION PARTIALLY FILLED, SEND REMAINING REQUIRMENT TO     MUL18240
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C   **  NEXT ECHELON.                                                    MUL18250
C                                                                        MUL18260
      IF(ORDQT(1) .LE. ISSUE) GO TO 122                                  MUL18270
         ORDQT(1) = ORDQT(1) - ISSUE                                     MUL18280
         GO TO 130                                                       MUL18290
  122 CONTINUE                                                           MUL18300
      REQN = REQN - 1                                                    MUL18310
C                                                                        MUL18320
CC  **  IF REQUISION FILLED, REMOVE FROM THE REQUISITION QUEUE.          MUL18330
CC  **  IF NONE REMAIN IN QUEUE, GO BACK TO MLSF OR ON TO ICP AS        MUL18340
CC  **  APPROPRIATE. IF REQUISITIONS REMAIN IN QUEUE, ATTEMPT TO        MUL18350
CC  **  FILL AT THIS ECHELON.                                           MUL18360
C                                                                        MUL18370
         IF(REQN .EQ. 0) GO TO 130                                       MUL18380
         DO 125 I = 1,REQN                                               MUL18390
              ORACT(I)=ORACT(I+1)                                        MUL18400
              RESON(I)=RESON(I+1)                                        MUL18410
              ORDQT(I)=ORDQT(I+1)                                        MUL18420
  125    CONTINUE                                                        MUL18430
         GO TO 110                                                       MUL18440
C                                                                        MUL18450
CC  **  IF NOT AVAILABLE FROM MLSF, ADD MLSF SCREENING DELAY TO SHIPMENT.MUL18460
C                                                                        MUL18470
  127 IF(HILIM(SSN,EQTYP) .EQ. 0) GO TO 128                              MUL18480
         NNN(EQTYP,ECH+1,2) = NNN(EQTYP,ECH+1,2) + 1                     MUL18490
         GO TO 129                                                       MUL18500
  128 NNN(EQTYP,ECH+1,3) = NNN(EQTYP,ECH+1,3) + 1                        MUL18510
  129 IF(SSN .EQ. 31 .OR. SSN .EQ. 32) MSD = MSDT                        MUL18520
  130 IF(SSN .EQ. 31 .OR. SSN .EQ. 32) GO TO 310                         MUL18530
      GO TO 400                                                          MUL18540
C                                                                        MUL18550
CC                                                                       MUL18560
CC  **  LABELS 200-210 REFER TO WEST COAST DEPOT.                       MUL18570
C                                                                        MUL18580
  200 CONTINUE                                                           MUL18590
      ECH = 2                                                            MUL18600
      SSN = 33                                                           MUL18610
      IF(COAST .EQ. 1) GO TO 210                                         MUL18620
         SSN = 34                                                        MUL18630
         ECH = 3                                                         MUL18640
  210 CONTINUE                                                           MUL18650
         GO TO 105                                                       MUL18660
C                                                                        MUL18670
CC                                                                       MUL18680
CC  **  LABELS 300-320 REFER TO MLSF.                                   MUL18690
C                                                                        MUL18700
  300 CONTINUE                                                           MUL18710
      ECH = 1                                                            MUL18720
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      SSN = 31                                                          MUL18730
      IF(COAST .EQ. 2) SSN = 32                                         MUL18740
      GO TO 105                                                         MUL18750
C                                                                       MUL18760
C  **  IF IP AT RECRDER POINT, SEND REQUISITICN TC NEXT ECHELON.        MUL18770
C                                                                       MUL18780
  310 CONTINUE                                                          MUL18790
      IF(HILIM(SSN,EQTYP) .EQ. 0) GO TO 320                             MUL18800
      IF(IP(SSN,EQTYP) .GT. REORD(SSN,EQTYP)) GO TO 320                 MUL18810
         REQN = REQN + 1                                                MUL18820
         ORACT(REQN) = SSN                                              MUL18830
         RESON(REQN) = 2                                                MUL18840
         ORDQT(REQN) = HILIM(SSN,EQTYP) - IP(SSN,EQTYP)                 MUL18850
         IP(SSN,EQTYP) = IP(SSN,EQTYP) + ORDQT(REQN)                    MUL18860
  320 CONTINUE                                                          MUL18870
C                                                                       MUL18880
C  **  IF REQUISITIONS IN QUEUE, GO TO NEXT ECHELON;                   MUL18890
C  **  ELSE RETURN TO 'TIGER'.                                         MUL18900
C                                                                       MUL18910
      IF(REQN .GT. 0) GO TO 200                                         MUL18920
      GO TO 495                                                         MUL18930
C                                                                       MUL18940
C                                                                       MUL18950
C  **  LABELS 400-495 REFER TO ICP                                     MUL18960
C                                                                       MUL18970
  400 CONTINUE                                                          MUL18980
C                                                                       MUL18990
C                                                                       MUL19000
C  **  LABEL 404-425 WILL REDISTRIBUTE ASSETS BETWEEN STOCK PCINTS FOR  MUL19010
C  **  MLSF AND SHIP REQUISITIONS.                                     MUL19020
C                                                                       MUL19030
  404 CONTINUE                                                          MUL19040
      IF(REQN .EQ. 0) GO TC 450                                         MUL19050
      IF(ORACT(1) .GT. 32) GO TO 450                                    MUL19060
      IF(SSN .NE. 33) GO TC 406                                         MUL19070
      IF(ONHND(35,EQTYP) .GE. 1) GO TO 408                              MUL19080
      IF(ONHND(34,EQTYP) .GE. 1) GO TO 409                              MUL19090
C                                                                       MUL19100
C  **  NONE AVAILABLE FOR REDISTRIBUTION, INDUCT CR PROCURE AS         MUL19110
C  **  APPROPRIATE (LABEL 460).                                        MUL19120
C                                                                       MUL19130
      GO TO 460                                                         MUL19140
  406 IF(SSN .EQ. 34) GO TO 407                                         MUL19150
      IF(ONHND(34,EQTYP) .GE. 1) GO TO 409                              MUL19160
      GO TO 460                                                         MUL19170
  407 IF(ONHND(35,EQTYP) .GE. 1) GO TO 408                              MUL19180
      GO TO 460                                                         MUL19190
  408 IA = 35                                                           MUL19200
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      COAST = 1                                                          MUL19210
      ECH = 3                                                            MUL19220
      GO TO 410                                                          MUL19230
  409 IA = 34                                                            MUL19240
      COAST = 2                                                          MUL19250
      ECH = 3                                                            MUL19260
C                                                                        MUL19270
CC  **  LABELS 410-425 REFER TO REDISTRIBUTION ISSUE PROCESS.            MUL19280
C                                                                        MUL19290
  410 ISSUE = MIN0(ONHND(IA,EQTYP),ORDQT(1))                             MUL19300
      ONHND(IA,EQTYP)=ONHND(IA,EQTYP) - ISSUE                            MUL19310
      DELOH(ECH+1) = DELOH(ECH+1) - ISSUE                                MUL19320
      IF(RPAIR(EQTYP) .EQ. 0) IP(38,EQTYP)=IP(38,EQTYP) - ISSUE          MUL19330
      DESTN = SHLCC                                                      MUL19340
      IF(ORACT(1) .GT. 30) DESTN = ORACT(1) - 24                         MUL19350
      SHIPR = IA - 24                                                    MUL19360
      NSHIP(SHIPR,DESTN) = NSHIP(SHIPR,DESTN) + 1                        MUL19370
      IF(RESON(1) .EQ. 2) GO TO 412                                      MUL19380
         SRT = OST(COAST,DESTN,ECH)                                      MUL19390
         IF(DESTN .LE. 6) SRT = SRT + MSD                                MUL19400
         IASRT = IA                                                      MUL19410
         CALL SWITCH(SRT,ORACT(1),EQTYP,DUEN,DUEA,DUEE,DUEQ,DUET)       MUL19420
         GO TO 414                                                       MUL19430
  412 CONTINUE                                                           MUL19440
      DTIME = OST(COAST,DESTN,ECH) + CTIME + SRT                         MUL19450
      IF(DESTN .LE. 6) DTIME = DTIME + MSD                               MUL19460
      CALL ESDUE(ORACT(1),EQTYP,DTIME,ISSUE,DUEN,DUEA,DUEE,DUEQ,DUET)   MUL19470
      DTOT = DTOT + 1                                                    MUL19480
      IDUEJ(1,DTOT) = ORACT(1)                                           MUL19490
      IDUEJ(2,DTOT) = INT(DTIME)                                         MUL19500
      IDUEJ(3,DTOT) = IA                                                 MUL19510
  414 CONTINUE                                                           MUL19520
      IF(ORDQT(1) .LE. ISSUE) GO TO 420                                  MUL19530
         ORDQT(1) = ORDQT(1) - ISSUE                                     MUL19540
         GO TO 425                                                       MUL19550
  420 CONTINUE                                                           MUL19560
         REQN = REQN - 1                                                 MUL19570
C                                                                        MUL19580
CC  **  IF NO REQUISITIONS IN QUEUE, CHECK ICP INVENTORY POSITION.       MUL19590
C                                                                        MUL19600
         IF(REQN .EQ. 0) GO TO 450                                       MUL19610
         DO 422 I=1,REQN                                                 MUL19620
              ORACT(I)=ORACT(I+1)                                        MUL19630
              RESON(I)=RESON(I+1)                                        MUL19640
              ORDQT(I)=ORDQT(I+1)                                        MUL19650
  422    CONTINUE                                                        MUL19660
  425 CONTINUE                                                           MUL19670
C                                                                        MUL19680
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C   **  THERE IS ANOTHER REQUISITION IN QUEUE.  IF FROM SHIP/MLSF          MUL19690
C   **  DETERMINE IF REDISTRIBUTION IS POSSIBLE.                           MUL19700
C                                                                          MUL19710
      GO TO 404                                                            MUL19720
C                                                                          MUL19730
C   **  LABELS 450-455 ESTABLISH REQUISITIONS FOR DEPOT AND CENTERS        MUL19740
C   **  IF ICP (SYSTEM) IP AT REORDER POINT.  THE ORDER QUANTITY IS        MUL19750
C   **  DIVIDED AND SENT TO THE STOCK POINTS BASED ON THEIR STOCK          MUL19760
C   **  DEFICIENCIES.                                                      MUL19770
C                                                                          MUL19780
  450 CONTINUE                                                             MUL19790
      IF(HILIM(38,EQTYP) .EQ. 0) GO TO 495                                 MUL19800
      IF(IP(38,EQTYP) .LE. REORD(38,EQTYP)) GO TO 451                      MUL19810
      GO TO 495                                                            MUL19820
  451 OQICP = HILIM(38,EQTYP) - IP(38,EQTYP)                               MUL19830
      IP(38,EQTYP)=IP(38,EQTYP) + OQICP                                    MUL19840
      DO 452 I=1,3                                                         MUL19850
         OQREQ(I)=HILIM(32+I,EQTYP) - ONHND(32+I,EQTYP)                    MUL19860
         ORDER(I)=0                                                        MUL19870
         IF(HILIM(32+I,EQTYP) .EQ. 0) OQREQ(I) = -9999                     MUL19880
  452 CONTINUE                                                             MUL19890
  453 ITEMA = 1                                                            MUL19900
      ITEMQ = OQREQ(1)                                                     MUL19910
      DO 454 I=2,3                                                         MUL19920
         IF(OQREQ(I) .LE. ITEMQ) GO TO 454                                 MUL19930
               ITEMA = I                                                   MUL19940
               ITEMQ = OQREQ(I)                                            MUL19950
  454 CONTINUE                                                             MUL19960
      ORDER(ITEMA)=ORDER(ITEMA)+1                                          MUL19970
      OQREQ(ITEMA)=OQREQ(ITEMA)-1                                          MUL19980
      OQICP=OQICP-1                                                        MUL19990
      IF(OQICP .GT. 0) GO TO 453                                           MUL20000
      DO 455 I=1,3                                                         MUL20010
         IF(ORDER(I) .EQ. 0) GO TO 455                                     MUL20020
         RECN = RECN + 1                                                   MUL20030
         ORACT(RECN) = I + 32                                              MUL20040
         RESON(RECN) = 2                                                   MUL20050
         ORQOT(RECN) = ORDER(I)                                            MUL20060
  455 CONTINUE                                                             MUL20070
C                                                                          MUL20080
C   **  LABELS 460-482 DETERMINE REPAIR INDUCTION REQUIREMENTS FOR         MUL20090
C   **  SHIP/MLSF REQUISITIONS AND SYSTEM ATTRITION REPLACEMENTS.          MUL20100
C                                                                          MUL20110
  460 CONTINUE                                                             MUL20120
      IF(RPAIR(EQTYP) .EQ. 0) GO TO 490                                    MUL20130
      RP = 37                                                              MUL20140
      COAST = 1                                                            MUL20150
      N = ORACT(1)                                                         MUL20160
```

```
      IF(N.LE.15 .OR. N.EQ.31 .OR. N.EQ.33 .OR. N.EQ.35) GO TO 465       MUL20170
         RP = 36                                                         MUL20180
         COAST = 2                                                       MUL20190
  465 CONTINUE                                                           MUL20200
  461 ISSUE = MINC(ONHND(RP,EQTYP),ORDQT(1))                             MUL20210
      IF(ISSUE .EQ. 0) GO TO 470                                         MUL20220
      CNHND(RP,EQTYP) = ONHND(RP,EQTYP) - ISSUE                          MUL20230
      DESTN = SHLCC                                                      MUL20240
      IF(ORACT(1) .GT. 30) DESTN = ORACT(1) - 24                         MUL20250
      SHIPR = RP - 24                                                    MUL20260
      NSHIP(SHIPR,DESTN) = NSHIP(SHIPR,DESTN) + 1                        MUL20270
      TO = LEVEL(DESTN)                                                  MUL20280
      NRF(EQTYP,TO,1) = NRF(EQTYP,TO,1) + 1                              MUL20290
      NRF(EQTYP,TO,2) = NRF(EQTYP,TO,2) + ISSUE                          MUL20300
      CALL LGAMA(IX3,A,ISSUE,1,0,ALFA1)                                  MUL20310
      DO 463 I=1,ISSUE                                                   MUL20320
      RTIME = MRT(EQTYP)*A(I)                                            MUL20330
      IF(RESON(1) .EQ. 2) GO TO 462                                      MUL20340
         SRT = RTIME + OST(COAST,DESTN,4)                                MUL20350
         IF(DESTN .LE. 6) SRT = SRT + MSD                                MUL20360
         IASRT = RP                                                      MUL20370
         CALL SWITCH(SRT,ORACT(1),EQTYP,DUEN,DUEA,DUEE,DUEQ,DUET)        MUL20380
         CALL PRICR(OST,EQTYP,DESTN,SRT,NSHIP,SHPR,DUEN,DUEA,DUEE,DUEQ,  MUL20390
     1   DUET)                                                           MUL20400
         IF(SHPR .EQ. 38) GO TO 464                                      MUL20410
         IASRT = SHPR                                                    MUL20420
         NSHIP(SHIPR,DESTN) = NSHIP(SHIPR,DESTN) - 1                     MUL20430
         NSHIP(SHIPR,SHPR-24) = NSHIP(SHIPR,SHPR-24) + 1                 MUL20440
         GO TO 464                                                       MUL20450
  462 CONTINUE                                                           MUL20460
         DTIME = RTIME + CTIME + OST(COAST,DESTN,4)                      MUL20470
         IF(DESTN .LE. 6) DTIME = DTIME + MSD                            MUL20480
         CALL ESDUE(ORACT(1),EQTYP,DTIME,1,DUEN,DUEA,DUEE,DUEQ,DUET)     MUL20490
         DTOT = DTOT + 1                                                 MUL20500
         IDUEJ(1,DTOT) = ORACT(1)                                        MUL20510
         IDUEJ(2,DTOT) = INT(DTIME)                                      MUL20520
         IDUEJ(3,DTOT) = RP                                              MUL20530
  463 CONTINUE                                                           MUL20540
  464 IF(ORDQT(1) .LE. ISSUE) GO TO 480                                  MUL20550
  470 CONTINUE                                                           MUL20560
C                                                                        MUL20570
CC   **  IF PARTIAL ORDER FILLED OR CARCASSES UNAVAILABLE FROM NEAREST   MUL20580
CC   **  REPAIR FACILITY, ATTEMPT TO FILL AT THE OTHER.                  MUL20590
C                                                                        MUL20600
      IF(RP .EQ. 36) GO TO 472                                           MUL20610
         RP = 36                                                         MUL20620
         COAST = 2                                                       MUL20630
         IF(ONHND(RP,EQTYP) .GE. 1) GO TO 461                            MUL20640
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      GO TO 490                                                          MUL20650
472 CONTINUE                                                             MUL20660
      RP = 37                                                            MUL20670
      COAST = 1                                                          MUL20680
      IF(CNHND(RP,EQTYP) .GE. 1) GO TO 461                               MUL20690
      GO TO 490                                                          MUL20700
480 CONTINUE                                                             MUL20710
    REQN = REQN - 1                                                      MUL20720
C                                                                        MUL20730
CC  **  IF NO REQUISITIONS IN QUEUE, DETERMINE IF SYSTEM IP AT REORDER PTMUL20740
C                                                                        MUL20750
    IF(REQN .EQ. 0) GO TO 450                                            MUL20760
    DO 482 I=1,REQN                                                      MUL20770
      ORACT(I)=ORACT(I+1)                                                MUL20780
      RESON(I)=RESON(I+1)                                                MUL20790
      ORDQT(I)=ORDQT(I+1)                                                MUL20800
482 CONTINUE                                                             MUL20810
    GO TO 460                                                            MUL20820
C                                                                        MUL20830
CC  **  LABELS 490-495 DETERMINE END USE AND SYSTEM REQUIREMENTS FOR     MUL20840
CC  **  PROCUREMENT FROM MANUFACTURER.                                   MUL20850
C                                                                        MUL20860
490 CONTINUE                                                             MUL20870
    ISSUE=ORDQT(1)                                                       MUL20880
    IF(RPAIR(EQTYP).EQ.1 .AND. ORACT(1).LE.30) IP(38,EQTYP) =            MUL20890
   X                                           IP(38,EQTYP) + ORDQT(1)   MUL20900
    COAST = 2                                                            MUL20910
    N = ORACT(1)                                                         MUL20920
    IF(N.LE.15 .OR. N.EQ.31 .OR. N.EQ.33 .OR. N.EQ.35) COAST = 1         MUL20930
    DESTN = SHLOC                                                        MUL20940
    IF(ORACT(1) .GT. 30) DESTN=ORACT(1)-24                               MUL20950
    NSHIP(14,DESTN) = NSHIP(14,DESTN) + 1                                MUL20960
    TO = LEVEL(CRACT(1))                                                 MUL20970
    NMFR(EQTYP,TO,1) = NMFR(EQTYP,TO,1) + 1                              MUL20980
    NMFR(EQTYP,TO,2) = NMFR(EQTYP,TO,2) + ISSUE                          MUL20990
    CALL LGAMA(IX4,A,1,1,0,ALFA2)                                        MUL21000
    PLT = MPLT(EQTYP)*A(1)                                               MUL21010
    IF(RESON(1) .EQ. 2) GO TO 492                                        MUL21020
      SRT=PLT + OSTM(DESTN)                                              MUL21030
      IF(DESTN .LE. 6) SRT = SRT + MSC                                   MUL21040
      IASRT = 38                                                         MUL21050
      CALL SWITCH(SRT,ORACT(1),EQTYP,DUEN,DUEA,DUEE,DUEQ,DUET)           MUL21060
      CALL PRICR(OST,EQTYP,DESTN,SRT,NSHIP,SHPR,DUEN,DUEA,DUEE,DUEQ,     MUL21070
   1  DUET)                                                              MUL21080
      IF(SHPR .EQ. 38) GO TO 494                                         MUL21090
           IASRT = SHPR                                                  MUL21100
           NSHIP(14,DESTN) = NSHIP(14,DESTN) - 1                         MUL21110
           NSHIP(14,SHPR-24) = NSHIP(14,SHPR-24) + 1                     MUL21120
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          GO TO 494                                                                    MUL21130
  492 CONTINUE                                                                         MUL21140
          DTIME = PLT + CTIME + OSTM(DESTN)                                            MUL21150
          IF(DESTN .LE. 6) CTIME = DTIME + MSD                                         MUL21160
          CALL ESDUE(ORACT(1),EQTYP,DTIME,ISSUE,DUEN,DUEA,DUEE,DUEQ,DUET)             MUL21170
          DTCT = DTCT + 1                                                              MUL21180
          IDUEJ(1,CTOT) = ORACT(1)                                                     MUL21190
          IDUEJ(2,CTOT) = INT(DTIME)                                                   MUL21200
          IDUEJ(3,CTOT) = 38                                                           MUL21210
  494 CONTINUE                                                                         MUL21220
      REQN = REQN -1                                                                   MUL21230
      IF(REQN .LE. 0) GO TO 450                                                        MUL21240
      DO 4941 I=1,REQN                                                                 MUL21250
          ORACT(I) = ORACT(I+1)                                                        MUL21260
          ORCQT(I) = ORCQT(I+1)                                                        MUL21270
          RESCN(I) = RESON(I+1)                                                        MUL21280
 4941 CONTINUE                                                                         MUL21290
      GO TO 460                                                                        MUL21300
  495 CONTINUE                                                                         MUL21310
C                                                                                      MUL21320
CCC   **  CALCULATE CHANGES IN ON-HAND INVENTORY LEVELS AT ALL ECHELONS               MUL21330
CCC   **  TO DETERMINE AVERAGE INVENTORY DOLLAR VALUE.                                MUL21340
C                                                                                      MUL21350
      DELTIM=CTIME-OTIME                                                               MUL21360
      DO 496 I=1,4                                                                     MUL21370
      DO 496 J=1,NTY                                                                   MUL21380
  496     SUMD(J,I) = SUMXD(J,I)*DELTIM  +   SUMD(J,I)                                 MUL21390
      DO 4961 I=1,4                                                                    MUL21400
          SUMD(EQTYP,I) =    .5*DELTIM*FLOAT(DELOH(I)) + SUMD(EQTYP,I)                 MUL21410
          SUMXD(EQTYP,I) = SUMXD(EQTYP,I) + DELOH(I)                                   MUL21420
 4961 CONTINUE                                                                         MUL21430
C                                                                                      MUL21440
CC    **  SUMMARY OF ACTION TAKEN                                                      MUL21450
C                                                                                      MUL21460
      IF(IOPTP1 .EQ. 0) GO TO 499                                                      MUL21470
      ICTIME = INT(CTIME)                                                              MUL21480
      NUM1 = NUM + 1                                                                   MUL21490
      ENUSE = ISHIP - 869                                                              MUL21500
      IF(OTIME .GT. 0.0) GO TO 4965                                                    MUL21510
          WRITE(6,695)NUM1                                                             MUL21520
 4965 WRITE(6,688)                                                                     MUL21530
      WRITE(6,680)EQTYP,ENUSE,ICTIME                                                   MUL21540
      WRITE(6,681)                                                                     MUL21550
      WRITE(6,683)IASRT,SRT                                                            MUL21560
      IF(DTCT .EQ. 0) GO TO 498                                                        MUL21570
      WRITE(6,684)                                                                     MUL21580
      WRITE(6,685)                                                                     MUL21590
      DO 497 I=1,CTOT                                                                  MUL21600
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      WRITE(6,686)IDUEJ(1,I),IDUEJ(2,I),IDUEJ(3,I)                      MUL21610
  497 CONTINUE                                                          MUL21620
      GO TO 499                                                         MUL21630
  498 WRITE(6,691)                                                      MUL21640
  499 CTIME = CTIME                                                     MUL21650
      RETURN                                                            MUL21660
  680 FORMAT('0',5X,'FAILURE OF EQUIPMENT TYPE',I3,' ON SHIP',I3,' AT TIMUL21670
     XME',I5,'.')                                                       MUL21680
  681 FORMAT(6X,'RESULTED IN THE FOLLOWING SUPPLY ACTIONS:')            MUL21690
  683 FORMAT('0','END USE REQUIREMENT FILLED BY SSN',I3,'.',4X,'SUPPLY RMUL21700
     XESPONSE TIME IS: ',F7.0)                                          MUL21710
  684 FORMAT('0', 'ORDERS FOR STOCK WERE GENERATED AS FOLLOWS:')        MUL21720
  685 FORMAT('0',5X,'REQUISITIONOR(SSN)',5X,'DUE-IN AT TIME',5X,'ISSUED MUL21730
     XFROM(SSN)'/)                                                      MUL21740
  686 FORMAT(10X,I4,20X,I5,16X,I2)                                      MUL21750
  688 FORMAT('0',80('-')/)                                              MUL21760
  695 FORMAT('1',20X,'MISSION: ',I4////)                                MUL21770
  691 FORMAT('0','NO ORDERS FOR STOCK RESULTED FROM THIS ISSUE.')       MUL21780
      END                                                               MUL21790
C                                                                       MUL21800
C                                                                       MUL21810
C                                                                       MUL21820
C                                                                       MUL21830
C                                                                       MUL21840
C                                                                       MUL21850
C                                                                       MUL21860
C                                                                       MUL21870
C  ************************************************************         MUL21880
C  **                                                        **         MUL21890
C  **  THIS SUBROUTINE UPDATES AN ACTIVITIE'S DUE-IN-FOR-STOCK VEC-  **  MUL21900
C  **  TOR. DUE-IN'S ARE FILED CHRONCLOGICALLY IN THE VECTOR (QUEUE).**  MUL21910
C  **                                                        **         MUL21920
C  ************************************************************         MUL21930
C                                                                       MUL21940
C                                                                       MUL21950
C                                                                       MUL21960
      SUBROUTINE ESDUE(ACT,EQTYP,DTIME,QTYD,DUEN,DUEA,DUEE,DUEQ,DUET)   MUL21970
      COMMON/MULTI/MAXD,MULTC,MFLAG,IOPTM,IRC,IOPTP1                    MUL21980
      INTEGER K,QTYD,KM1,ACT,EQTYP,DUEN                                 MUL21990
      INTEGER DUEA(MAXD),DUEQ(MAXD),DUEE(MAXD)                          MUL22000
      REAL DUET(MAXD),CTIME                                             MUL22010
      K = DUEN + 1                                                      MUL22020
      IF((K+1) .GE. MAXD) GO TO 25                                      MUL22030
C                                                                       MUL22040
C  **  THIS LOOP FINDS PROPER PLACE IN QUEUE AND MOVES OTHERS ACCORDINLYMUL22050
C                                                                       MUL22060
      DO 20 I=1,K                                                       MUL22070
         IF(DTIME .GE. DUET(I)) GO TO 20                                MUL22080
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      KMI=K-I                                                                   MUL22090
      IF(KMI .EQ. 0) GO TO 16                                                   MUL22100
      DO 15 J=1,KMI                                                             MLL22110
           DUET(K+1-J) = DUET(K-J)                                              MUL22120
           DUEA(K+1-J) = DUEA(K-J)                                              MLL22130
           DUEQ(K+1-J) = DUEQ(K-J)                                              MLL22140
           DUEE(K+1-J) = DUEE(K-J)                                              MUL22150
15    CONTINUE                                                                  MUL22160
16    DUET(I) = DTIME                                                           MUL22170
      DUEA(I) = ACT                                                             MUL22180
      DUEQ(I) = QTYD                                                            MUL22190
      DUEE(I) = EQTYP                                                           MUL22200
      GO TO 21                                                                  MUL22210
20 CONTINUE                                                                     MLL22220
21 DUEN = K                                                                     MUL22230
   GO TO 30                                                                     MLL22240
25 CONTINUE                                                                     MUL22250
   WRITE(6,600)ACT                                                              MUL22260
600 FORMAT('0',5X,'WARNING: THE NUMBER OF DUE-INS FOR ACTIVITY NR',I4,          MLL22270
  1' HAS EXCEEDED MAX ALLOWABLE.',/,'SIMULATION CONTINUES, BUT DUE-IN           MUL22280
  2WILL NOT BE RECORDED FOR THIS ACTIVITY UNTIL SPACE IS AVAILABLE.')           MLL22290
   STOP                                                                         MUL22300
30 CONTINUE                                                                     MLL22310
   RETURN                                                                       MUL22320
   END                                                                          MUL22330
                                                                                MUL22340
C                                                                               MUL22350
C                                                                               MUL22360
C                                                                               MUL22370
C                                                                               MUL22380
C                                                                               MUL22390
C                                                                               MLL22400
C  ************************************************************************** MUL22410
C  **                                                                      ** MUL22420
C  **  THIS SUBROUTINE DETERMINES IF ANY DUE-IN'S HAVE ARRIVED AT          ** MLL22430
C  **  OR BEFORE CURRENT TIME.  IF SO, IT ELIMINATES THOSE DUE-IN'S        ** MUL22440
C  **  FROM THE QUEUE AND CALCULATES THE QUANTITY RECEIVED.                ** MLL22450
C  **                                                                      ** MUL22460
C  ************************************************************************** MUL22470
C                                                                               MUL22480
C                                                                               MUL22490
C                                                                               MUL22500
      SUBROUTINE CHKDU(SSN,EQTYP,CTIME,DUEN,DUEA,DUEE,DUEQ,DUET,DUES)           MUL22510
C                                                                               MUL22520
      COMMON/MULTI/MAXD,MULTC,MFLAG,IOPTM,IRC,IOPTP1                            MUL22530
      INTEGER DUES,SSN,EQTYP,DUEN                                               MUL22540
      INTEGER DUEA(MAXD),DUEE(MAXD),DUEQ(MAXD)                                  MUL22550
      REAL DUET(MAXD),CTIME                                                     MUL22560
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C                                                                       MUL22570
      DUES=C                                                            MUL22580
      K=0                                                               MUL22590
C                                                                       MUL22600
CC    **  CALCULATE TOTAL DUES                                          MUL22610
C                                                                       MUL22620
   10 K = K+1                                                           MUL22630
      IF(DUET(K) .GT. CTIME) GO TO 20                                   MUL22640
      IF(DUEA(K) .NE. SSN) GO TO 10                                     MUL22650
      IF(DUEE(K) .NE. EQTYP) GO TO 10                                   MUL22660
         DUES = DUEQ(K) + DUES                                          MUL22670
         KR = DUEN+1                                                    MUL22680
C                                                                       MUL22690
CC    **  ADJUST DUE-IN VECTOR AS NECESSARY.                            MUL22700
C                                                                       MUL22710
         DO 15 I = K,KR                                                 MUL22720
              DUET(I) = DUET(I+1)                                       MUL22730
              DUEQ(I) = DUEQ(I+1)                                       MUL22740
              DUEE(I) = DUEE(I+1)                                       MUL22750
              DUEA(I) = DUEA(I+1)                                       MUL22760
              DUEN = DUEN - 1                                           MUL22770
   15    CONTINUE                                                       MUL22780
         GO TO 10                                                       MUL22790
   20 CONTINUE                                                          MUL22800
      RETURN                                                            MUL22810
      END                                                               MUL22820
C                                                                       MUL22830
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC MUL22840
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CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC MUL23020
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC MUL23030
      SUBROUTINE PRIOR(OST,EQTYP,DESTN,SRT,NSHIP,SHPR,DUEN,DUEA,DUEE,   MUL23040
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     1   DUEQ,DUET)                                                                  MUL23C50
C                                                                                    MUL23060
      COMMON/MULTI/MAXD,MULTC,MFLAG,IOPTM,IRC,IOPTP1                                 MUL23070
      INTEGER SHPR,ECH,COAST,DESTN,ECTYP,NSHIP(14,14),DUEN,DNUM                      MUL23080
      INTEGER DUEA(MAXD),DUEE(MAXD),DUEQ(MAXD)                                       MUL23090
      REAL MIN,T,CST(2,14,3),SRT,DTIME,SRT1,CTIME,DUET(MAXD)                         MUL23100
C                                                                                    MUL23110
      SHPR=C                                                                         MUL23120
      SRT1=SRT                                                                       MUL23130
      MIN=$$999                                                                      MUL23140
C                                                                                    MUL23150
      IF(DUEN .EQ. 0) GO TO 51                                                       MUL23160
      DO 10 J=1,DUEN                                                                 MUL23170
         IF(DUET(J) .GE. SRT) GO TO 11                                               MUL23180
         IF(DUEE(J) .NE. ECTYP) GO TC 10                                             MUL23190
         IF(DUEA(J).GT.35 .CR. DUEA(J).LT.33) GO TO 10                               MUL23200
         ECH = 3                                                                     MUL23210
         IF(DUEA(J) .EC. 33) ECH = 2                                                 MUL23220
         COAST = 1                                                                   MUL23230
         IF(DUEA(J) .EC. 34) COAST = 2                                               MUL23240
         T = DUET(J) + CST(CCAST,DESTN,ECH)                                          MUL23250
         IF(T .GE. MIN) GO TO 10                                                     MUL23260
               SHPR=DUEA(J)                                                          MUL23270
               MIN = T                                                               MUL23280
               DNUM = J                                                              MUL23290
   10 CONTINUE                                                                       MUL23300
   11 CONTINUE                                                                       MUL23310
      IF(SHPR .EQ. 0 .OR. MIN .GE. SRT) GO TO 50                                     MUL23320
      SHPR1 = SHPR - 24                                                              MUL23330
      NSHIP(SHPR1,DESTN) = NSHIP(SHPR1,DESTN) + 1                                    MUL23340
      SRT=MIN                                                                        MUL23350
      DUEQ(DNUM) = DUEQ(DNUM) - 1                                                    MUL23360
C                                                                                    MUL23370
CC ** IF THE DUE-IN QUANTITY WAS ONE, ELIMINATE THE DUE-IN FROM QUEUE.               MUL23380
C                                                                                    MUL23390
      IF(DUEQ(DNUM) .NE. 0) GO TO 20                                                 MUL23400
         DO 12 I=DNUM,DUEN                                                           MUL23410
               DUEA(I) = DUEA(I+1)                                                   MUL23420
               DUEE(I) = DUEE(I+1)                                                   MUL23430
               DUEQ(I) = DUEQ(I+1)                                                   MUL23440
               DUET(I) = DUET(I+1)                                                   MUL23450
   12    CONTINUE                                                                    MUL23460
         DUEN = DUEN - 1                                                             MUL23470
   20 CONTINUE                                                                       MUL23480
C                                                                                    MUL23490
CC ** INSERT NEW DUE-IN IN SHIPPER'S DUE-IN QUEUE.                                   MUL23500
C                                                                                    MUL23510
      DTIME=SRT1-CST(CCAST,DESTN,ECH) + CTIME                                        MUL23520
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      CALL ESDUE(SHPR,EQTYP,CTIME,1,CUEN,DUEA,DUEE,DUEQ,DUET)          MUL23530
      GO TO 51                                                         MUL23540
   50 CONTINUE                                                         MUL23550
      SHPR = 38                                                        MUL23560
   51 CONTINUE                                                         MUL23570
      RETURN                                                           MUL23580
      END                                                              MUL23590
                                                                       MUL23600
C                                                                      MUL23610
C                                                                      MUL23620
C                                                                      MUL23630
C                                                                      MUL23640
C                                                                      MUL23650
C                                                                      MUL23660
C*****************************************************************   MUL23670
C**                                                             **   MUL23680
C**  WHEN A SUPPLY RESPONSE TIME IS ESTABLISHED FOR AN END-USER,**   MUL23690
C**  SUBROUTINE 'SWITCH' WILL CHECK THE END-USERS DUE-IN FILE TO**   MUL23700
C**  TO ASCERTAIN IF ANY EQUIPMENTS OF THIS TYPE ARE DUE IN FOR **   MUL23710
C**  STOCK AT A TIME PRIOR TO THE SRT.  IF SO, THE EARLIEST SUCH**   MUL23720
C**  STOCK DUE WILL BE SWITCHED TO SATISFY THE END USE REQUIRE- **   MUL23730
C**  MENT WHILE THE INCOMING SRT WILL BE DIVERTED TO STOCK.     **   MUL23740
C**                                                             **   MUL23750
C*****************************************************************   MUL23760
C                                                                      MUL23770
C                                                                      MUL23780
C                                                                      MUL23790
C                                                                      MUL23800
      SUBROUTINE SWITCH(SRT,ACT,EQTYP,DUEN,DUEA,DUEE,DUEQ,DUET)        MUL23810
C                                                                      MUL23820
      COMMON/MULTI/MAXD,MULTC,MFLAG,IOPTN,IRC,IOPTP1                   MUL23830
      INTEGER DUEN,DNUM                                                MUL23840
      INTEGER DUEA(MAXD),DUEE(MAXD),DUEQ(MAXD)                         MUL23850
      REAL SRT,SRT1,DUET(MAXD)                                         MUL23860
C                                                                      MUL23870
      SRT1 = SRT                                                       MUL23880
      IFLAG = 0                                                        MUL23890
      IF(DUEN .EQ. 0) GO TO 50                                         MUL23900
      DO 10 J=1,DUEN                                                   MUL23910
         IF(DUET(J) .GE. SRT) GO TO 11                                 MUL23920
         IF(DUEA(J).NE.ACT .OR. DUEE(J).NE.EQTYP) GO TO 10             MUL23930
         DNUM = J                                                      MUL23940
         SRT = DUET(J)                                                 MUL23950
         IFLAG = 1                                                     MUL23960
         GO TO 11                                                      MUL23970
   10 CONTINUE                                                         MUL23980
   11 CONTINUE                                                         MUL23990
      IF(IFLAG .EQ. 0) GO TO 50                                        MUL24000
```

```
      DUEQ(DNUM) = DUEQ(DNUM) - 1                                       MUL24010
      IF(DUEQ(DNUM) .NE. 0) GO TO 20                                    MUL24020
         DO 12 I = DNUM,DUEN                                            MUL24030
               DUEA(I) = DUEA(I+1)                                      MUL24040
               DUEE(I) = DUEE(I+1)                                      MUL24050
               DUEQ(I) = DUEQ(I+1)                                      MUL24060
               DUET(I) = DUET(I+1)                                      MUL24070
   12    CONTINUE                                                       MUL24080
         DUEN = DUEN - 1                                                MUL24090
   20 CONTINUE                                                          MUL24100
      DTIME = SRT1                                                      MUL24110
      CALL ESDUE(ACT,EQTYP,DTIME,1,DUEN,DUEA,DUEE,DUEQ,DUET)            MUL24120
   50 CONTINUE                                                          MUL24130
      RETURN                                                            MUL24140
      END                                                               MUL24150
C                                                                       MUL24160
C                                                                       MUL24170
C                                                                       MUL24180
C                                                                       MUL24190
C                                                                       MUL24200
C                                                                       MUL24210
CCCCCCCCCC*************************************************************MUL24220
CCCCCCCCCC**                                                         **MUL24230
CCCCCCCCCC**  SUBROUTINE 'MPACK' READS AND INITIALIZES INPUT VARIABLES FOR **MUL24240
CCCCCCCCCC**  THE 'MULTE' SUBROUTINE.  THE INITIAL DOLLAR VALUE INVESTED   **MUL24250
CCCCCCCCCC**  IN INVENTORY IS CALCULATED FOR ALL ECHELONS.  ADDITIONALLY,  **MUL24260
CCCCCCCCCC**  AT THE START OF EACH MISSION, IT RESETS APPROPRIATE VARI-    **MUL24270
CCCCCCCCCC**  ABLES TO THEIR INITAIL CONDITIONS.                          **MUL24280
CCCCCCCCCC**                                                         **MUL24290
CCCCCCCCCC*************************************************************MUL24300
C                                                                       MUL24310
C                                                                       MUL24320
C                                                                       MUL24330
C                                                                       MUL24340
      SUBROUTINE MPACK(ERQ,HILIM,IP,ONHND,MPLT,MRT,MSDT,REORD,          MUL24350
     1RPAIR,CTIME,DUEA,DUEE,DUEQ,DUET,DUEN,NTY)                         MUL24360
C                                                                       MUL24370
      COMMON/MULTI/MAXD,MULTC,MFLAG,IOPTM,IRC,IOPTP1                    MUL24380
      COMMON/STAT/XD(200,4),XT(4),XG,SUMD(200,4),SUMXD(200,4)           MUL24390
      COMMON/ISTAT/NIST,NMFR(200,4,2),NNN(200,4,3),NRA,NRRT,            MUL24400
     1NRF(200,4,2),NSHIP(14,14),IXD(200,4),IXT(4),IXG                   MUL24410
      COMMON/MP/CRAR,ALFA1,ALFA2,SSRT,ECCST(200),CSTSR(6),OSTM(11),     MUL24420
     1CST(2,11,4)                                                       MUL24430
      COMMON/NS/NUMSS(30),NRSHPS,ITOTEQ,NSSEQ(500),NRWCS                MUL24440
      INTEGER DUEN                                                      MUL24450
      INTEGER DUEA(MAXD),DUEE(MAXD),DUEQ(MAXD),IP(38,200),ERQ(200),     MUL24460
     1HILIM(38,200),ONHND(38,200),RECRD(38,200),RPAIR(200),NSSS(30)     MUL24470
      REAL DUET(MAXD),MPLT(200),MRT(200),MSDT                           MUL24480
```

```
C                                                                       MUL24490
CC      DATA ERQ/200*0/,HILIM/7600*0/,RECRD/7600*0/,OSTM/11*0.0/,       MUL24500
CCC    1OSTSR/6*0.0/,OST/88*0.0/                                        MUL24510
C                                                                       MUL24520
       MFLAG = 1                                                        MUL24530
       IF(MULTC .NE. 0) GO TO 50                                        MUL24540
       READ(5,502)M1,CRAR,MSDT,SSRT,ALFA1,ALFA2                         MUL24550
       DO 20 J=1,NTY                                                    MUL24560
          READ(5,504)RPAIR(J),MPLT(J),ECOST(J)                          MUL24570
          IF(RPAIR(J) .EQ. 1) READ(5,506)MRT(J),ERQ(J)                  MUL24580
          GO TO (5,20),M1                                               MUL24590
    5     READ(5,508)HILIM(NUMSS(1)-869,J),(HILIM(I,J),I=31,38)         MUL24600
          READ(5,508)RECRD(NUMSS(1)-869,J),(RECRD(I,J),I=31,38)         MUL24610
          IF(NRSHPS .EQ. 1) GO TO 20                                    MUL24620
          DO 10 K=2,NRSHPS                                              MUL24630
               NMS = NUMSS(K)-869                                       MUL24640
               NMS1 = NUMSS(1)-869                                      MUL24650
               HILIM(NMS,J) = HILIM(NMS1,J)                             MUL24660
   10          RECRD(NMS,J) = RECRD(NMS1,J)                             MUL24670
   20  CONTINUE                                                         MUL24680
       GO TO (40,25),M1                                                 MUL24690
   25  DO 33 I=1,NRSHPS                                                 MUL24700
       NMS=NUMSS(I)-869                                                 MUL24710
          READ(5,512)(HILIM(I,J),J=1,NTY)                               MUL24720
   33     READ(5,512)(RECRD(I,J),J=1,NTY)                               MUL24730
       DO 35 I=31,38                                                    MUL24740
          READ(5,512)(HILIM(I,J),J=1,NTY)                               MUL24750
   35     READ(5,512)(RECRD(I,J),J=1,NTY)                               MUL24760
   40  CONTINUE                                                         MUL24770
       READ(5,516)(OSTSR(I),I=1,6)                                      MUL24780
       READ(5,516)(OSTM(I),I=1,11)                                      MUL24790
       DO 46 I=1,2                                                      MUL24800
          DO 46 K=1,4                                                   MUL24810
   46        READ(5,516)(OST(I,J,K),J=1,11)                            MUL24820
C                                                                       MUL24830
       WRITE(6,600)                                                     MUL24840
       WRITE(6,602)NRSHPS                                               MUL24850
       WRITE(6,604)NTY                                                  MUL24860
       WRITE(6,606)                                                     MUL24870
       WRITE(6,608)                                                     MUL24880
       WRITE(6,610)                                                     MUL24890
       DO 100 I=1,NTY                                                   MUL24900
  100     WRITE(6,612)I,RPAIR(I),MPLT(I),MRT(I),ECOST(I),ERQ(I)         MUL24910
       WRITE(6,626)                                                     MUL24920
       WRITE(6,627)                                                     MUL24930
       WRITE(6,6271)                                                    MUL24940
       DO 1011 I=1,NRSHPS                                               MUL24950
          NSSS(I) = NUMSS(I) - 869                                      MUL24960
```

```
 1011 CONTINUE                                                          MUL24970
      NRS = NRSHPS                                                      MUL24980
      IF(NRSHPS .GT. 15) NRS = 15                                       MUL24990
      I1 = 1                                                            MUL25000
  101 WRITE(6,628)(NSSS(I),I=I1,NRS)                                    MUL25010
      WRITE(6,629)                                                      MUL25020
      DO 103 I=1,NTY                                                    MUL25030
         WRITE(6,630)I,(HILIM(NUMSS(J)-869,I),J=I1,NRS)                 MUL25040
         WRITE(6,632)(RECRD(NUMSS(J)-869,I),J=I1,NRS)                   MUL25050
  103 CONTINUE                                                          MUL25060
      IF(NRSHPS.LE.15 .OR. I1.EQ.16) GO TO 104                          MUL25070
      I1 = 16                                                           MUL25080
      NRS = NRSHPS                                                      MUL25090
      GO TO 101                                                         MUL25100
  104 WRITE(6,634)                                                      MUL25110
      WRITE(6,635)                                                      MUL25120
      WRITE(6,629)                                                      MUL25130
      DO 105 I=1,NTY                                                    MUL25140
         WRITE(6,636)I,(HILIM(J,I),J=31,38)                             MUL25150
         WRITE(6,638)(RECRD(J,I),J=31,38)                               MUL25160
  105 CONTINUE                                                          MUL25170
      WRITE(6,614)                                                      MUL25180
      WRITE(6,616)                                                      MUL25190
      WRITE(6,618)(I,I=1,14)                                            MUL25200
      DO 110 I=1,3                                                      MUL25210
  110    WRITE(6,620)I,OSTSR(I)                                         MUL25220
      DO 115 I=4,6                                                      MUL25230
  115    WRITE(6,622)I,OSTSR(I)                                         MUL25240
      IA = 1                                                            MUL25250
      IB = 2                                                            MUL25260
      IC = 7                                                            MUL25270
      DO 120 K=1,4                                                      MUL25280
         IF(K.EQ.1 .OR. K.EQ.2) GO TO 118                               MUL25290
               IA = 2                                                   MUL25300
               IB = 1                                                   MUL25310
  118    WRITE(6,624)IC,(OST(IA,J,K),J=1,11)                            MUL25320
         IC = IC + 1                                                    MUL25330
         IF(K .EQ. 2) GO TO 120                                         MUL25340
         WRITE(6,624)IC,(OST(IB,J,K),J=1,11)                            MUL25350
         IC = IC + 1                                                    MUL25360
  120 CONTINUE                                                          MUL25370
      WRITE(6,624)IC,(CSTM(I),I=1,11)                                   MUL25380
C                                                                       MUL25390
      IXT(1) = 0                                                        MUL25400
      DO 1002 I=1,NTY                                                   MUL25410
         IXD(I,1) = 0                                                   MUL25420
         DO 1001 J=1,30                                                 MUL25430
              IXD(I,1) = HILIM(J,I) + IXD(I,1)                          MUL25440
```

```
1001     CONTINUE                                                          MUL25450
         IXT(1) = IXD(I,1) + IXT(1)                                        MUL25460
1002 CONTINUE                                                              MUL25470
     IXG = IXT(1)                                                          MUL25480
     ITEMP = 28                                                            MUL25490
     DO 1004 I=2,4                                                         MUL25500
        ITEMP = ITEMP + 2                                                  MUL25510
        IF(I .EQ. 4) ITEMP = ITEMP-1                                       MUL25520
        IXT(I) = 0                                                         MUL25530
        DO 1003 J=1,NTY                                                    MUL25540
           IXD(J,I)=0                                                      MUL25550
           IXD(J,I) = HILIM(ITEMP+1,J) + IXD(J,I)                          MUL25560
           IF( I .NE. 3) IXD(J,I) = HILIM(ITEMP+2,J) + IXD(J,I)            MUL25570
           IXT(I) = IXD(J,I) + IXT(I)                                      MUL25580
1003    CONTINUE                                                           MUL25590
        IXG = IXT(I) + IXG                                                 MUL25600
1004 CONTINUE                                                              MUL25610
     XG = 0.0                                                              MUL25620
     DO 1114 I=1,4                                                         MUL25630
        XT(I) = 0.0                                                        MUL25640
        DO 1113 J=1,NTY                                                    MUL25650
           XD(J,I) = FLOAT(IXD(J,I))*ECOST(J)                              MUL25660
           XT(I) = XD(J,I) + XT(I)                                         MUL25670
           SUMD(J,I)=0.0                                                   MUL25680
1113       SUMXD(J,I) = 0.0                                                MUL25690
1114    XG = XT(I) + XG                                                    MUL25700
     NRRT = 0                                                              MUL25710
     NRA = 0                                                               MUL25720
     NIST = 0                                                              MUL25730
     DO 1125 K=1,3                                                         MUL25740
        DO 1125 J=1,4                                                      MUL25750
           DO 1125 I=1,NTY                                                 MUL25760
              IF(K .EQ. 3) GO TO 1120                                      MUL25770
              NMFR(I,J,K) = 0                                              MUL25780
              NRF(I,J,K) = 0                                               MUL25790
1120          NNN(I,J,K) = 0                                               MUL25800
1125 CONTINUE                                                              MUL25810
     DO 113C I=1,14                                                        MUL25820
        DO 1130 J=1,14                                                     MUL25830
1130       NSHIP(I,J) = 0                                                  MUL25840
C                                                                          MUL25850
C                                                                          MUL25860
   50 CTIME = 0.0                                                          MUL25870
      DO 51 I=1,4                                                          MUL25880
         DO 51 J=1,NTY                                                     MUL25890
   51       SUMXD(J,I) = FLOAT(IXD(J,I))                                   MUL25900
      DUEN = 0                                                             MUL25910
      DO 55 I=1,MAXD                                                       MUL25920
```

```
      DUEA(I) = 0                                                       MUL25930
      DUEE(I) = 0                                                       MUL25940
      DUEQ(I) = 0                                                       MUL25950
   55 DUET(I) = 99999.                                                  MUL25960
      DO 60 I=1,38                                                      MUL25970
      DO 60 J=1,NTY                                                     MUL25980
         IP(I,J) = HILIM(I,J)                                           MUL25990
   60    ONHND(I,J) = HILIM(I,J)                                        MUL26000
      RETURN                                                            MUL26010
  502 FORMAT(I5,5F10.0)                                                 MUL26020
  504 FORMAT(I10,2F10.0)                                                MUL26030
  506 FORMAT(F10.0,I10)                                                 MUL26040
  508 FORMAT(9I5)                                                       MUL26050
  512 FORMAT(16I5/)                                                     MUL26060
  516 FORMAT(11F7.0)                                                    MUL26070
  600 FORMAT('1',5X,'INPUT PARAMETERS:  MULTI-ECHELON SUPPLY SYSTEM')   MUL26080
  602 FORMAT('0',8X,'NUMBER OF SHIPS IN SIMULATION:',2X,I3)             MUL26090
  604 FORMAT(9X,'NUMBER OF EQUIPMENT TYPES:',I4)                        MUL26100
  606 FORMAT('0',8X,'EQUIPMENT TYPE DATA')                              MUL26110
  608 FORMAT('0','EQUIP     REPAIR     MEAN PROCMT     MEAN REPAIR     EMUL26120
     1QUIP     ECONOMIC')                                               MUL26130
  610 FORMAT(1X,'NR',8X,'CODE',7X,'LEAD TIME',8X,'LEAD TIME',7X,'COST',  MUL26140
     15X,'REPAIR QTY',/)                                               MUL26150
  612 FORMAT(1X,I2,10X,I1,9X,F7.2,10X,F7.2,6X,F7.2,5X,I4)               MUL26160
  614 FORMAT(///,' ORDER AND SHIPPING TIMES')                           MUL26170
  616 FORMAT('0',5X,'TO',6X,'SHIP LOCATION',11X,'MLSF   DEPOT   CENTERS MUL26180
     1  REP FAC    MFR')                                               MUL26190
  618 FORMAT(1X,'FROM',2X,I2,13(3X,I2))                                 MUL26200
  620 FORMAT(1X,I2,63X,F5.0)                                            MUL26210
  622 FORMAT(1X,I2,58X,F5.0)                                            MUL26220
  624 FORMAT(1X,I2,1X,11(F5.0))                                         MUL26230
  626 FORMAT(////,5X,'INVENTORY STOCKING OBJECTIVE/  BY ACTIVITY')      MUL26240
  627 FORMAT(16X,'REORDER POINT')                                       MUL26250
 6271 FORMAT(1X,'SHIPS')                                                MUL26260
  628 FORMAT('0',8X,'SHIP NR.',2X,15(I4))                               MUL26270
  629 FORMAT(1X,'EQUIPMENT')                                            MUL26280
  630 FORMAT('0',3X,I3,12X,15(I4))                                      MUL26290
  632 FORMAT(19X,15(I4))                                                MUL26300
  634 FORMAT(8X,'ACTIVITY:  MLSF-W MLSF-E DEPOT CENTER-E CENTER-W REP-E MUL26310
     1REP-W    ICP')                                                   MUL26320
  635 FORMAT(1X,'SUPPORT ACTIVITIES')                                   MUL26330
  636 FORMAT('0',3X,I3,12X,3(2X,I4),3X,I4,4X,I4,2X,2(2X,I4),3X,I4)      MUL26340
  638 FORMAT(19X,3(2X,I4),3X,I4,4X,I4,2X,2(2X,I4),3X,I4)                MUL26350
C     DEBUG INIT(XD,XT,XG,DVII,TDVII,GTDVI,ADV,ATDV,AGTV)               MUL26360
C     AT 5                                                              MUL26370
      END                                                               MUL26380
C                                                                       MUL26390
C                                                                       MUL26400
```

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C                                                                               MUL26410
C                                                                               MUL26420
CCC ***************************************************************************MUL26430
CCC **                                                                         **MUL26440
CCC **  SUBROUTINE 'MSTAT' COMPILES AND PRINTS END-OF-RUN STATISTICS           **MUL26450
CCC **  FOR THE MULTI-ECHELON SUPPLY NETWORK.                                  **MUL26460
CCC **                                                                         **MUL26470
CCC ***************************************************************************MUL26480
CCCCCCC                                                                         MUL26490
                                                                                MUL26500
                                                                                MUL26510
                                                                                MUL26520
      SUBROUTINE MSTAT(ITMSN,NTY,TPM,IOPT)                                      MUL26530
C                                                                               MUL26540
      COMMON/STAT/XD(200,4),XT(4),XG,SUMD(200,4),SUMXD(200,4)                   MUL26550
      COMMON/ISTAT/NIST,NMFR(200,4,2),NNN(200,4,3),NRA,NRRT,                    MUL26560
     1NRF(200,4,2),NSHIP(14,14),IXD(200,4),IXT(4),IXG                           MUL26570
      COMMON/MP/CRAR,ALFA1,ALFA2,SSRT,ECCST(200),OSTSR(6),OSTM(11),             MUL26580
     1OST(2,11,4)                                                               MUL26590
      COMMON/MULTI/MAXD,MULTC,MFLAG,IOPTM,IRC,IOPTP1                            MUL26600
      INTEGER NMFL(4,2),NMFE(200,2),NMFT(2),NRFL(4,2),NRFE(200,2),              MUL26610
     1NRFT(2),NNNL(4,3),NNNE(200,3),NNNT(3),IEQ(200)                            MUL26620
      REAL ANMFE(200,2),ANMFL(4,2),ANMFT(2),ANRFE(200,2),ANRFL(4,2),            MUL26630
     1ANRFT(2),ANNN(200,4,3),ANNNE(200,3),ANNNL(4,3),ANSHIP(14,14),             MUL26640
     2AADV(200,4),AATDV(4),ANNNT(3),SUMDM(200,4),CSUMDM(200,4)                  MUL26650
                                                                                MUL26660
CCC** COMPUTE CROSS SUMS AND TOTALS                                             MUL26670
C                                                                               MUL26680
      DO 10 K=1,3                                                               MUL26690
         DO 8 I=1,NTY                                                           MUL26700
            IF(K .EQ. 3) GO TO 4                                                MUL26710
            NMFE(I,K) = 0                                                       MUL26720
            NRFE(I,K) = 0                                                       MUL26730
 4          NNNE(I,K) = 0                                                       MUL26740
            DO 6 J=1,4                                                          MUL26750
               IF(K .EQ. 3) GO TO 5                                             MUL26760
               NMFE(I,K) = NMFR(I,J,K) + NMFE(I,K)                              MUL26770
               NRFE(I,K) = NRF(I,J,K) + NRFE(I,K)                               MUL26780
 5             NNNE(I,K) = NNN(I,J,K) + NNNE(I,K)                               MUL26790
 6          CONTINUE                                                            MUL26800
 8       CONTINUE                                                               MUL26810
10    CONTINUE                                                                  MUL26820
      DO 30 K = 1,3                                                             MUL26830
         IF(K.EQ.3) GO TO 12                                                    MUL26840
         NMFT(K) = 0                                                            MUL26850
         NRFT(K) = 0                                                            MUL26860
12       NNNT(K) = 0                                                            MUL26870
         DO 25 J = 1,4                                                          MUL26880
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```
                IF(K.EQ.3) GO TO 14                                                  MUL26890
                NMFL(J,K) = 0                                                        MUL26900
                NRFL(J,K) = 0                                                        MUL26910
   14           NNNL(J,K) = 0                                                        MUL26920
                DO 20 I = 1,NTY                                                      MUL26930
                     IF(K.EQ.3) GO TO 16                                             MUL26940
                     NMFL(J,K) = NMFR(I,J,K) + NMFL(J,K)                             MUL26950
                     NRFL(J,K) = NRF(I,J,K) + NRFL(J,K)                              MUL26960
   16                NNNL(J,K) = NNN(I,J,K) + NNNL(J,K)                              MUL26970
   20           CONTINUE                                                            MUL26980
                IF(K.EQ.3) GO TO 22                                                  MUL26990
                NMFT(K) = NMFL(J,K) + NMFT(K)                                        MUL27000
                NRFT(K) = NRFL(J,K) + NRFT(K)                                        MUL27010
   22           NNNT(K) = NNNL(J,K) + NNNT(K)                                       MUL27020
   25      CONTINUE                                                                  MUL27030
   30 CONTINUE                                                                       MUL27040
C                                                                                    MUL27050
      NSPT = 0                                                                       MUL27060
      DO 60 I=7,14                                                                   MUL27070
         DO 55 J = 1,11                                                              MUL27080
            NSPT = NSPT + NSHIP(I,J)                                                 MUL27090
   55    CONTINUE                                                                    MUL27100
   60 CONTINUE                                                                       MUL27110
C                                                                                    MUL27120
CC ** COMPUTE AVERAGES PER MISSION.                                                  MUL27130
C                                                                                    MUL27140
      TMSN=FLOAT(ITMSN)                                                              MUL27150
      WRITE(6,7000)TMSN                                                              MUL27160
 7000 FORMAT('0',5X,'TOTAL NR OF MISSIONS IS: ',F5.0)                                MUL27170
      DO 110 K= 1,3                                                                  MUL27180
         DO 100 I=1,NTY                                                              MUL27190
            IF(K .EQ. 3) GO TO 90                                                    MUL27200
            ANMFE(I,K) = (FLOAT(NMFE(I,K)))/TMSN                                     MUL27210
            ANRFE(I,K) = (FLOAT(NRFE(I,K)))/TMSN                                     MUL27220
   90       ANNNE(I,K) = (FLOAT(NNNE(I,K)))/TMSN                                     MUL27230
  100    CONTINUE                                                                    MUL27240
         DO 105 J=1,4                                                                MUL27250
            IF(K .EQ. 3) GO TO 102                                                   MUL27260
            ANMFL(J,K) = (FLOAT(NMFL(J,K)))/TMSN                                     MUL27270
            ANRFL(J,K) = (FLOAT(NRFL(J,K)))/TMSN                                     MUL27280
  102       DO 103 L=1,NTY                                                         MUL27290
               ANNN(L,J,K) = (FLOAT(NNN(L,J,K)))/TMSN                              MUL27300
  103       CONTINUE                                                               MUL27310
            ANNNL(J,K) = (FLOAT(NNNL(J,K)))/TMSN                                     MUL27320
  105    CONTINUE                                                                    MUL27330
         IF(K .EQ. 3) GO TO 107                                                      MUL27340
         ANMFT(K) = (FLOAT(NMFT(K)))/TMSN                                            MUL27350
         ANRFT(K) = (FLOAT(NRFT(K)))/TMSN                                            MUL27360
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  107     ANANT(K) = (FLOAT(ANNT(K)))/TMSN                                  MUL27370
  110 CONTINUE                                                              MUL27380
      ANRRT = (FLOAT(NRRT))/TMSN                                            MUL27390
      ANIST = (FLOAT(NIST))/TMSN                                            MUL27400
      ANRA = (FLOAT(NRA))/TMSN                                              MUL27410
      ANSPT = (FLOAT(NSPT))/TMSN                                            MUL27420
      DO 115 I=7,14                                                         MUL27430
         DO 113  J=1,11                                                     MUL27440
            ANSHIP(I,J) = (FLOAT(NSHIP(I,J)))/TMSN                          MUL27450
  113    CONTINUE                                                           MUL27460
  115 CONTINUE                                                              MUL27470
      DO 120 J=1,4                                                          MUL27480
         DO 120 I=1,NTY                                                     MUL27490
            SUMDM(I,J) = SUMD(I,J)/TMSN                                     MUL27500
            CSUMDM(I,J) = SUMDM(I,J)*ECOST(I)                               MUL27510
            AADV(I,J) = CSUMDM(I,J)/TPM                                     MUL27520
  120 CONTINUE                                                              MUL27530
      AAGTV = 0.0                                                           MUL27540
      DO 128 I=1,4                                                          MUL27550
         AATDV(I) = 0.0                                                     MUL27560
         DO 124 J=1,NTY                                                     MUL27570
            AATDV(I) = AADV(J,I) + AATDV(I)                                 MUL27580
  124    CONTINUE                                                           MUL27590
         AAGTV = AATDV(I) + AAGTV                                           MUL27600
  128 CONTINUE                                                              MUL27610
      DO 130 I=1,NTY                                                        MUL27620
         IEQ(I) = I                                                         MUL27630
  130 CONTINUE                                                              MUL27640
C                                                                           MUL27650
C  **  WRITE OUTPUT SUMMARIES.                                              MUL27660
C                                                                           MUL27670
      WRITE(6,600)                                                          MUL27680
      WRITE(6,602)ITMSN                                                     MUL27690
      WRITE(6,603)                                                          MUL27700
      WRITE(6,688)                                                          MUL27710
      WRITE(6,604)                                                          MUL27720
      IF(IOPT .EQ. 2) GO TO 200                                             MUL27730
      WRITE(6,606)                                                          MUL27740
      WRITE(6,608)                                                          MUL27750
      WRITE(6,610)(ANMFL(I,1),I=1,4)                                        MUL27760
      WRITE(6,612)(ANMFL(I,2),I=1,4)                                        MUL27770
  200 IF(IOPT .EQ. 1) GO TO 205                                             MUL27780
      WRITE(6,614)                                                          MUL27790
      DO 202 I=1,NTY,11                                                     MUL27800
         I10 = I + 10                                                       MUL27810
         WRITE(6,616)(IEQ(J),J=I,I10)                                       MUL27820
         WRITE(6,620)(ANMFE(J,1),J=I,I10)                                   MUL27830
         WRITE(6,622)(ANMFE(J,2),J=I,I10)                                   MUL27840
```

```
202 CONTINUE                                                            MUL27850
205 WRITE(6,688)                                                        MUL27860
    WRITE(6,624)                                                        MUL27870
    IF(IOPT .EQ. 2) GO TO 208                                           MUL27880
    WRITE(6,606)                                                        MUL27890
    WRITE(6,626)                                                        MUL27900
    WRITE(6,628)(ANRFL(I,1),I=1,4)                                      MUL27910
    WRITE(6,630)(ANRFL(I,2),I=1,4)                                      MUL27920
208 IF(IOPT .EQ. 1) GO TO 212                                           MUL27930
    WRITE(6,614)                                                        MUL27940
    DO 210 I=1,NTY,11                                                   MUL27950
       I10 = I + 10                                                     MUL27960
       WRITE(6,616)(IEQ(J),J=I,I10)                                     MUL27970
       WRITE(6,632)(ANRFE(J,1),J=I,I10)                                 MUL27980
       WRITE(6,634)(ANRFE(J,2),J=I,I10)                                 MUL27990
210 CONTINUE                                                            MUL28000
212 WRITE(6,636)ANRRT                                                   MUL28010
    WRITE(6,638)ANRA                                                    MUL28020
    WRITE(6,688)                                                        MUL28030
    WRITE(6,640)                                                        MUL28040
    WRITE(6,642)                                                        MUL28050
    WRITE(6,644)                                                        MUL28060
    WRITE(6,646)(IEQ(I),I=1,11)                                         MUL28070
    WRITE(6,648)(ANSHIP(7,I),I=1,11)                                    MUL28080
    WRITE(6,650)(ANSHIP(8,I),I=1,11)                                    MUL28090
    WRITE(6,652)(ANSHIP(9,I),I=1,11)                                    MUL28100
    WRITE(6,654)(ANSHIP(10,I),I=1,11)                                   MUL28110
    WRITE(6,656)(ANSHIP(11,I),I=1,11)                                   MUL28120
    WRITE(6,658)(ANSHIP(12,I),I=1,11)                                   MUL28130
    WRITE(6,660)(ANSHIP(13,I),I=1,11)                                   MUL28140
    WRITE(6,662)(ANSHIP(14,I),I=1,11)                                   MUL28150
    WRITE(6,664)ANIST                                                   MUL28160
    WRITE(6,688)                                                        MUL28170
    WRITE(6,666)                                                        MUL28180
    WRITE(6,668)                                                        MUL28190
    WRITE(6,670)                                                        MUL28200
    IF(IOPT .EQ. 1) GO TO 220                                           MUL28210
    WRITE(6,672)                                                        MUL28220
    DO 214 I =1,NTY                                                     MUL28230
       WRITE(6,674)IEQ(I),(XD(I,J),J=1,4)                               MUL28240
214 CONTINUE                                                            MUL28250
220 CONTINUE                                                            MUL28260
    WRITE(6,676)(XT(I),I=1,4)                                           MUL28270
    WRITE(6,678)XG                                                      MUL28280
    WRITE(6,680)                                                        MUL28290
    WRITE(6,670)                                                        MUL28300
    IF(IOPT .EQ. 1) GO TO 224                                           MUL28310
    WRITE(6,672)                                                        MUL28320
```

```
      DO 224 I=1,NTY                                                    MUL28330
         WRITE(6,674)IEQ(I),(AADV(I,J),J=1,4)                           MUL28340
  224 CONTINUE                                                          MUL28350
      WRITE(6,676)(AATDV(J),J=1,4)                                      MUL28360
      WRITE(6,678)AAGTV                                                 MUL28370
      WRITE(6,688)                                                      MUL28380
      WRITE(6,682)                                                      MUL28390
      WRITE(6,683)                                                      MUL28400
      IF(IOPT .EQ. 1) GO TO 230                                         MUL28410
      WRITE(6,672)                                                      MUL28420
      DO 230 I=1,NTY                                                    MUL28430
       WRITE(6,684)IEQ(I),((ANNN(I,J,K),K=1,3),J=1,4),(ANNNE(I,K),K=1,3)MUL28440
                                                                        MUL28450
  230 CONTINUE                                                          MUL28460
      WRITE(6,685)((ANNNL(I,K),K=1,3),I=1,4)                            MUL28470
      WRITE(6,686)(ANNNT(K),K=1,3)                                      MUL28480
      WRITE(6,688)                                                      MUL28490
      RETURN                                                            MUL28500
C                                                                       MUL28510
  600 FORMAT('1',20X,'DATA SUMMARY:  MULTI-ECHELON SUPPLY SYSTEM')      MUL28520
  602 FORMAT('0',5X,I4,' SIMULATED MISSIONS HAVE BEEN RUN.  THE FOLLLOWI MUL28530
     XNG')                                                              MUL28540
  603 FORMAT(6X,'SUMMARY STATISTICS ARE BASED ON AVERAGE NUMBERS PER MIS MUL28550
     XSION.')                                                           MUL28560
  604 FORMAT('0',5X,'I.  PROCUREMENT COSTS')                            MUL28570
  606 FORMAT('0',10X,'ECHELON SUMMARY')                                 MUL28580
  608 FORMAT('0',4X,'SHIPPED FROM MFR TO:',7X,'SHIPS',7X,'MLSF',7X,     MUL28590
     X 'DEPOT',7X,'SUPPLY CENTERS',/)                                   MUL28600
  610 FORMAT(1X,'NR. PROCUREMENTS',7X,3(8X,F4.1),12X,F4.1)              MUL28610
  612 FORMAT(1X,'NR. ITEMS PROCURED',5X,3(8X,F4.1),12X,F4.1)            MUL28620
  614 FORMAT('0',10X,'EQUIPMENT SUMMARY',/)                             MUL28630
  616 FORMAT(5X,'EQUIPMENT NR.',11(2X,I3))                              MUL28640
  620 FORMAT(1X,'NR. PROCUREMENTS',2X,11(1X,F4.1))                      MUL28650
  622 FORMAT(1X,'NR. ITEMS PROCURED',11(1X,F4.1))                       MUL28660
  624 FORMAT('0',5X,'II.  REPAIR COSTS',/)                              MUL28670
  626 FORMAT('0',5X,'SHIPPED FR REPAIR FACILITY TO:',4X,'SHIPS',4X,     MUL28680
     X 'MLSF',4X,'DEPOT',4X,'SUPPLY CENTERS',/)                         MUL28690
  628 FORMAT(1X,'NR. INDUCTIONS',19X,3(5X,F4.1),9X,F4.1)                MUL28700
  630 FORMAT(1X,'NR. ITEMS INDUCTED',21X,F4.1,2(5X,F4.1),9X,F4.1)       MUL28710
  632 FORMAT(1X,'NR. INDUCTIONS',4X,11(1X,F4.1))                        MUL28720
  634 FORMAT(1X,'NR. ITEMS INDUCTED',11(1X,F4.1))                       MUL28730
  636 FORMAT('0',5X,'NR. ITEMS RETURNED BY SHIPS TO REPAIR FACILITIES:', MUL28740
     X F4.1)                                                            MUL28750
  638 FORMAT('0',5X,'NR. REPAIRABLE CARCASSES LOST DUE TO ATTRITION:',  MUL28760
     X F6.1)                                                            MUL28770
  640 FORMAT('0',5X,'III.  TRANSPORTATION COSTS (NR. SHIPMENTS)')       MUL28780
  642 FORMAT('0',30X,'DESTINATION ACTIVITY')                            MUL28790
  644 FORMAT('0',18X,'(DESTINATIONS 1-6 REFER TO SHIP LOCATIONS)')      MUL28800
  646 FORMAT(15X,11(4X,I2))
```

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  648 FORMAT(5X,'MLSF-W  (7)',11(2X,F4.1))                                  MUL28810
  650 FORMAT(1X,'S',7X,'-E  (8)',11(2X,F4.1))                               MUL28820
  652 FORMAT(1X,'H',5X,'DEPOT (9)',11(2X,F4.1))                             MUL28830
  654 FORMAT(1X,'I CENTER-E (10)',11(2X,F4.1))                              MUL28840
  656 FORMAT(1X,'P',7X,'-W (11)',11(2X,F4.1))                               MUL28850
  658 FORMAT(1X,'P REPAIR-E (12)',11(2X,F4.1))                              MUL28860
  660 FORMAT(1X,'E',7X,'-W (13)',11(2X,F4.1))                               MUL28870
  662 FORMAT(1X,'R',6X,'MFR (14)',11(2X,F4.1))                              MUL28880
  664 FORMAT('0',5X,'TOTAL NR. OF ISSUES FROM SHIP STOCK:',F4.1)            MUL28890
  666 FORMAT('0','IV.  INVENTORY COSTS')                                    MUL28900
  668 FORMAT('0',20X,'INITIAL INVENTORY INVESTMENT')                        MUL28910
  670 FORMAT('0',10X,'ECHELON:',10X,'SHIPS',9X,'MLSF',10X,'DEPOT',7X,       MUL28920
     X 'CENTERS')                                                           MUL28930
  672 FORMAT(5X,'EQUIPMENT')                                                MUL28940
  674 FORMAT(7X,I3,10X,4(4X,F10.2))                                         MUL28950
  676 FORMAT('0',11X,'TOTALS:',2X,4(4X,F10.2))                              MUL28960
  678 FORMAT('0',20X,'TOTAL INVESTMENT:',F12.2)                             MUL28970
  680 FORMAT('0',20X,'AVERAGE ON-HAND INVENTORY DOLLAR VALUE')              MUL28980
  682 FORMAT('0',5X,'V.  DEMAND HISTORY (TOTAL/NIS/NC)')                    MUL28990
  683 FORMAT('0',5X,'ECHELON:',3X,'SHIPS',9X,'MLSF',10X,'DEPOT',8X,         MUL29000
     X  'CENTERS',8X,'TOTAL')                                               MUL29010
  684 FORMAT(8X,I3,5(2X(F4.1,'/',F3.1,'/',F3.1)))                           MUL29020
  685 FORMAT(5X,'TOTAL',4(1X(F5.1,'/',F4.1,'/',F4.1)))                      MUL29030
  686 FORMAT('0',20X,'GRAND TOTAL:   ',F6.1,'/',F5.1,'/',F5.1)              MUL29040
  688 FORMAT('0',80('-'),/)                                                 MUL29050
C     DEBUG INIT(XD,AADV,AATDV,AAGTV,ADV,ATDV,AGTV,TMSN,TPM)                MUL29060
C     AT 1                                                                  MUL29070
      END                                                                   MUL29080
```

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